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HENRY H. SMITH, M.D.,

FESSOR OF SURGERY IN THE UNIVERSITY OF PENNSYLVANIA, ETC.

IN TWO VOLUMES.

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THE PRINCIPLES

AND

PRACTICE OF SURGERY.

REGIONAL DISORDERS AND OPERATIONS.

INTRODUCTORY REMARKS.

In the consideration of the Principles and Practice of Surgery, as hitherto presented, attention has been mainly directed to the disorders noted in connection with the different tissues of the body, without any special reference to their relative positions to each other. By this means the subject has been studied in detail mainly as it related to the efforts of nature, aided by art, in the process of repair, or in such modifications of disordered nutrition as constituted the special diseases of each tissue.

In the present volume the subject of Regional Disorders and the operations demanded for their relief, will be investigated, rather in reference to the anatomical relations of the varied parts that compose the region under discussion, than in view of the pathological changes created by disease—omitting in this consideration such general characteristics as have been already alluded to. Thus, under the regional division of the Head, Neck, Chest, etc., there will be given such an account of special disorders and operations as are mainly seen in these portions of the body, while, at the same time, attention can be readily given to the influence of such structures and organs as are met with in the region under examination. When operations are performed on regions, as the eyes, ears, nose, etc., it is also desirable that the surgeon should have a clear recollection of the anatomical relations of the parts operated. Hence the account of each operation will be preceded by a topographical description of the anatomy of the structures liable to be involved in the operator's proceedings. In the prosecution of this plan, the subject will be presented in the usual topographical order of the anatomist, and studied, first, as limited to the region of the Head and Face, then of the Neck, Chest, Abdomen, and Genito-urinary Organs, reserving for the Extremities, the varied operations of the ligation of arteries, amputation, resections, etc.

PART XII.

DISORDERS AND OPERATIONS ON THE HEAD AND FACE.

As the disorders and operations connected with the Head and Face embrace two distinct regions not specially bearing on each other, they may be advantageously studied separately.

CHAPTER I.

DISORDERS AND OPERATIONS ON THE HEAD.

THE regional disorders specially requiring operative treatment, in connection with the Head, may be studied as limited to the scalp, or as involving the bones of the cranium. The surgical disorders of the Scalp, under this arrangement, will embrace the various forms of tumors met with in this structure, as well as the injuries and diseases of its blood-vessels. Those involving the Cranium will be referred to as due to fracture and tumors, or other disorders of the bones of the skull. Before examining the peculiarities of either class, attention should be given to the surgical relations of the constituent parts of the head as a region.

SECTION I.

SURGICAL ANATOMY OF THE HEAD.

THE HEAD, as a Surgical Region, is divided into two parts: one, the **Cranium**, being all that portion of the bony structure occupied by the **Brain**; the other, the **Face**, being the region bounded above by the supercilliæ, and below by the base of the inferior maxilla. In the cavity of the cranium, anatomists recognize two distinct portions: one, the superior, which is designated as the **Vault**; the other, the inferior, usually called the **Base**. With the **Base** of the cranium a surgeon has but little to do, it being so situated and connected with vital parts of the nervous system as to forbid, as a general rule, the application of instruments to it, except in its lateral

PLATE V.

INSTRUMENTS EMPLOYED IN TREPHINING AND OTHER OPERATIONS ON THE BONES.

Fig. 1. The Circular Saw of Martin, of Paris. 1. The handle. 2. The shaft. 3. The double joint. 4. The saw. This most useful instrument consists of a shaft to which circular as well as mushroom-shaped saws or circular gouges may be adapted by a screw. These saws may be made to revolve rapidly by means of the brace, Fig. 2. In consequence of the double joint at 3, the saw can be kept in motion, no matter what may be the relative position of the shaft to which the brace is attached, except when the two are at a right angle. This saw is to be employed by the surgeon holding the handle, 1, while the assistant turns the brace, Fig. 2, when attached to the shaft at 2. I have used this saw in several instances, and found it an excellent instrument. *Charriere's pattern.*

Fig. 3. The Mushroom Saw, and Fig. 4, the Circular Saw, belonging to Fig. 1. *Charriere's pattern.*

Fig. 5. Hey's Saw. *Kolbè's pattern.*

Fig. 6. Barton's Metacarpal Saw. " "

Fig. 7. A fine flexible "Keyhole" Saw, for incising the bones of the face. *Kolbè's pattern.*

Fig. 8. The "Chain Saw," with the needle attached for carrying one end round a bone. *Charriere's pattern.*

Fig. 9. The Handles, to be attached to the saw after the needle is removed. *Charriere's pattern.*

Fig. 10. A Trephine of large size. 1. The crown. 2. The slide to raise the centre-pin. *Kolbè's pattern.*

Fig. 11. A smaller Trephine. " "

Fig. 12. A short, stiff Brush to clean the teeth of the trephine. " "

Fig. 13. An Elevator for raising a depressed bone. " "

Fig. 14. A Lenticular Knife, for the removal of spiculæ from the opening in the skull made by a trephine. *Kolbè's pattern.*

Fig. 15. A Scraper or Raspatory, useful in caries, etc. " "

Fig. 16. A Steel Hammer, or Mallet. *Charriere's pattern.*

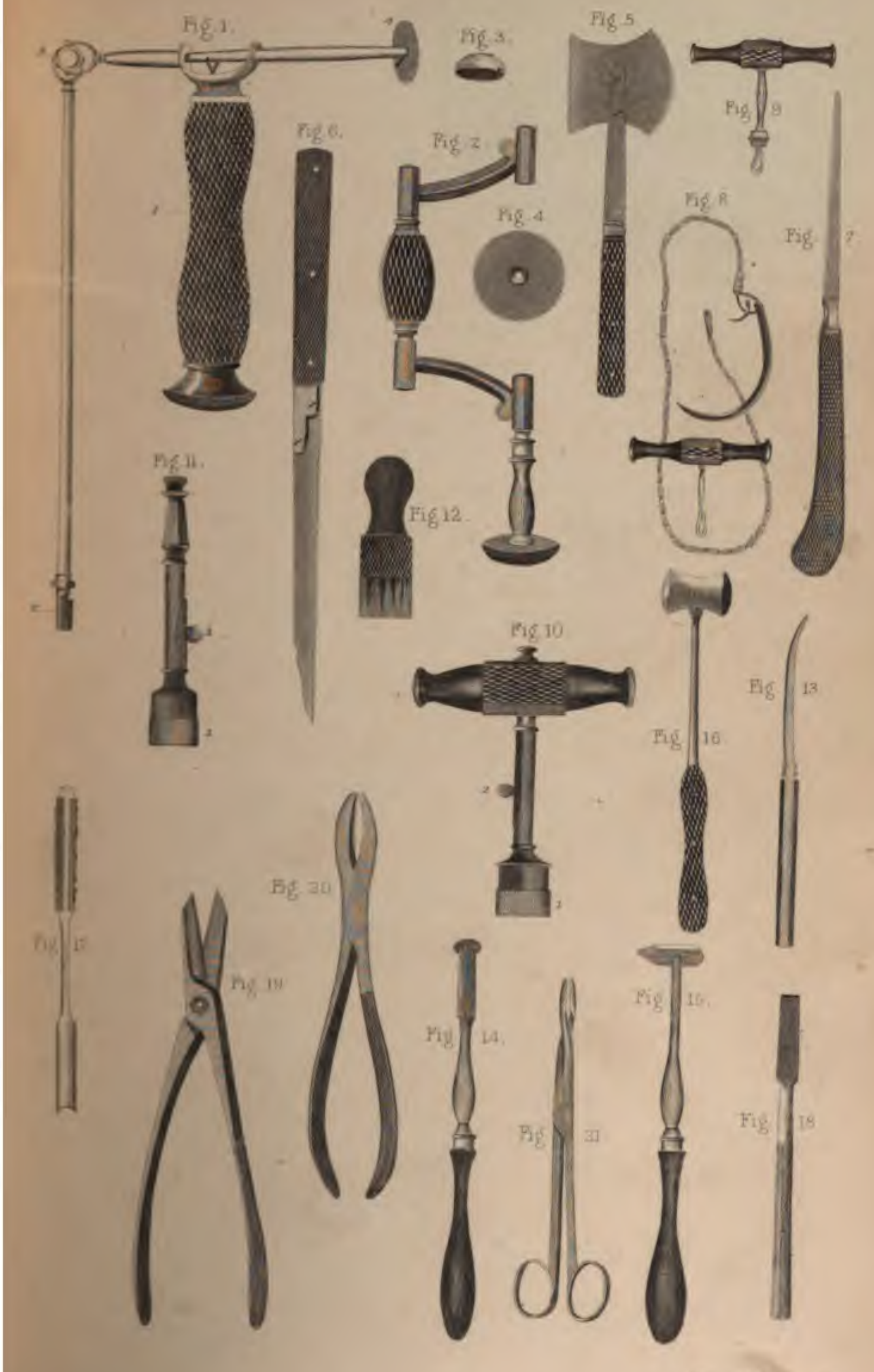
Fig. 17. A Steel Gouge, with the shaft passing through a wooden handle. *Charriere's pattern.*

Fig. 18. A chisel of the same kind. " "

Fig. 19. Liston's strong Bone Nippers. *Kolbè's pattern.*

Fig. 20. Strong Bone Forceps, for removing sequestra in Necrosis. *Kolbè's pattern.*

Plate 5



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portion, where, in rare cases, it is necessary to perforate the mastoid cells, in order to relieve deafness.

The **Vault** of the cranium is mainly important to the surgeon in consequence of the relations existing between the bones which compose it and the internal parts. These bones are so arranged as to form a cavity which is accurately filled by the brain. They are of the class known as flat bones, and consist of two layers of compact matter with an intermediate diploë or cancellated structure, which contains a large number of veins or sinuses. The layers or tables of the skull are covered and nourished by an endosteum, which is the outer lamina of the dura mater, as well as by an external membrane called the Pericranium. In all operations upon the vault of the cranium, the pericranium should be disturbed as little as possible, and always reapplied to the skull, Rodier and others having shown that it is capable of reproducing bone when thus replaced in connection with the scalp.

The **Dura Mater,** or fibrous covering of the brain, is attached to the internal table of the skull by fibrous and vascular adhesions, and is regarded as useful in the nourishment of this table. In its duplicatures are found several large veins or sinuses, the principal of which, on its upper part, is the Superior Longitudinal Sinus, Plate VII. Fig. 1. This sinus runs from before backward, in the median line of the cranium, and is liable to be injured if a trephine is applied in its course. Several arterial branches are also found within the vault of the cranium, outside the dura mater, and often more or less deeply imbedded in the inner table of the skull. Of these arteries, the most important to the surgeon is the meningea media, or middle artery of the dura mater, which is first noticed within the cranium, near the level of the external angular process of the os frontis and the anterior angle of the parietal bone, whence it ramifies in numerous anastomosing branches, Plate VII. Fig. 1. This vessel, like the longitudinal sinus, is also liable to be wounded in the operation of trephining, and, when opened, is sometimes ligated with difficulty, in consequence of its deep channel in the bone. Cases, however, are recorded in which hemorrhage from it and from the superior longitudinal sinus has been arrested by pressure with lint. The Pericranium, or periosteum of the cranial bones, adheres closely to their external surface, especially at the sutures, and by its vascular connections assists in preserving the vitality of the outer table of the skull.

Outside of the pericranium, upon the summit of the vault, is found the tendon, and at the front and back of the same region the bellies of the occipito-frontalis muscle, the fibres of which run nearly vertically. The course of these fibres should direct the line of all incisions in this region, a transverse wound of the scalp being occasionally difficult to heal, from the retraction of its edges caused by the action of the muscle. The connective tissue between the occipito-frontalis tendon and the pericranium is freely developed, and attaches these two parts so loosely together that the tendon and muscle move with great facility upon the pericranium. The connective tissue between the tendon and the teguments is, on the contrary, sparsely developed, uniting the two tissues very closely together. In this layer is found a small amount of fat, as well as the tegumentary blood-vessels and nerves; it is also the seat of most of the tumors found upon the scalp, the flattened and spheroidal shape of which is mainly due to the closeness of the structure and its want of extensibility. This sparse connective tissue is one cause of the great liability of the scalp to take on erysipelatous inflammation; and the rapidity with which the disease runs on to mortification is owing to the nutritive vessels of the integuments being compressed against the cranium, whenever effusions occur in its dense and unyielding structure. Its character will also be noticed in any attempt to place a ligature upon a divided vessel in the scalp, the difficulty of drawing out the vessel being due to the peculiarity just referred to. The skin immediately above this layer contains the hair and sebaceous follicles, both of which may become the seat of disordered nutrition.

In studying the structure of the scalp from its surface to the bones, we have, therefore, 1st, the skin with its hairs and follicles; 2d, a dense connective tissue, closely adherent to surrounding parts, that contains fat, as well as most of the blood-vessels and nerves; 3d, the occipito-frontalis muscle and its tendon; 4th, a loose areolar substance that permits free motion of the muscle and tendon upon the parts beneath; and, 5th, the pericranium closely adherent to all parts of the bones, but especially to the sutures. Wounds of the scalp are very apt to separate the integuments from the pericranium, in consequence of its loose connections; but as the tegumentary vessels usually remain in the flap, it is generally only necessary to replace the latter in its proper position, in order to enable the parts to heal. The density of the tissue, and the tendency of suppurations to travel in the connective tissue between the tendon of the occipito-frontalis and the pericranium, should always be borne in mind in injuries or operations on this region. Sutures employed to unite these parts should only pass to the tendon, and not beneath it, and the metallic sutures are generally to be preferred to any other, as being less irritating.

The anatomical relations of the Face will be referred to hereafter.

SECTION II.

DISORDERS AND OPERATIONS UPON THE HEAD.

Wounds of the Head and Fractures of the Skull having been previously alluded to, the operations required in the treatment of the disorders of this region may now be studied. These consist of such as are necessary for the relief of affections of the soft parts, and those demanded by injuries and diseases of the bones or dura mater. In all these cases the surgeon will find it a useful preliminary measure to shave the scalp freely before commencing his operation, except in extirpating small encysted sebaceous tumors, where the presence of the adjacent hair, the tumors themselves being bare, will be useful as a means of promoting the approximation of the incisions, union being generally in these cases so prompt as to enable the patient to avoid the notice generally excited by a shorn scalp.

§ 1.—Operations upon the Scalp.

Among the affections of the scalp most frequently requiring surgical interference are Encysted Tumors, and Nævi or Vascular Tumors.

I. Cystoma or **Encysted Tumors** of the Scalp, like those seen elsewhere, are of various kinds, and, when found in this region, are usually situated in some portion of the scalp exterior to the occipito-frontalis tendon. They are seldom covered with hair, the distention of the skin by the growth of the tumor usually destroying the action of the hair follicles.

The variety of encysted tumors anciently called Atheromatous or Melicerous, contains cheesy or more liquid matter, and are generally regarded as due to obstructed and enlarged sebaceous follicles, as before stated.* They are most frequently located immediately beneath the skin. Unless of long standing and of some size, these tumors do not adhere to the pericranium; but, when more fully developed, they sometimes induce such inflammatory action in this membrane as results in adhesion, and, in some instances, in cartilaginous degeneration of that portion of the pericranium next to the sac. Occasionally I have seen these tumors induce direct absorption of the outer table of the skull, so as to create a cup-like cavity, the edge of which was rough and slightly elevated. No blood-vessels enter these tumors, their organization being low.

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* Vol. i. p. 360.

Ordinary Operation.—If the tumor is small, pass a sharp-pointed, narrow bistoury, with the back to the cranium, directly through its middle, and cut the sac open from within outward. Then, after squeezing out the contents, reflect the edge of the skin so as to retain it in one pair of forceps, while the divided edge of the sac is seized in another pair, and drawn out from its attachments. If the adhesions, however, are strong, careful dissection may be necessary to free the tumor from the pericranium, lest the latter membrane be injured and necrosis supervene.

In large encysted tumors, it is sometimes necessary to make an elliptical incision through the scalp, so as to remove such portions of the latter as would prove superabundant; then, puncturing the sac, proceed as before; but encysted tumors of a size requiring this mode of operating are rare, and any apparent excess of scalp will usually disappear soon after the removal of the sac, or cause no inconvenience to the patient. To attempt a dissection of the entire cyst is both tedious and useless.

Dressing.—Cleanse the part thoroughly; see that no portion of the shining sac remains at the bottom of the wound, and tie or twist a few adjacent hairs together over the wound, in order to close it, or, if the incision has been free, apply a compress and bandage. The hemorrhage seldom requires attention, or may be easily arrested by pressure, being usually so slight as seldom to demand even a bandage.

II. Aneurism by Anastomosis, or **Erectile Tumors.**—A class of tumors formed chiefly by enlarged capillaries united together by free connective tissue, and before described* as Angionoma or Telangiectasis, is sometimes found on the scalp as well as in other portions of the body. In most instances, these tumors only involve the integuments, and are supplied by one or two vessels which, entering near the centre of the structure, have no direct vascular connection with the skin of the adjacent parts. Most frequently they will be found of small size, though they occasionally attain the dimensions of an orange. Being composed almost entirely of enlarged capillaries, as before stated,† the hemorrhage from them will be free when the diseased structure is incised, though it is slight, and generally amenable to pressure, when the incisions are kept out of the new growth.

Operations.—When seated in the scalp, these tumors may be eradicated by various means of treatment, the object of all being to interrupt the supply of blood to the tumor, or to remove the tumor entire from the surrounding tissues.

In small tumors the development of moderate inflammation in the diseased part will often suffice to produce an obliteration of its circulation, after which the hypertrophied structure will either slough out or waste away; but, in other instances, constriction of the tumor by ligatures or pressure may be required to accomplish the same object, though the most certain mode of cure will be found in extirpation. In all cases of anastomosing aneurism it is important to operate at an early period, as its growth is often rapid, and the

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* Vol. i. p. 365.

† Ibid.

PLATE VI.

OPERATIONS UPON THE SCALP AND SKULL.

Fig. 1. A front view of an Angionoma on the forehead of a child, showing the combination of incision and strangulation as recommended by Liston. Four flaps, formed by a crucial incision simply through the skin, have been turned off, and two needles, armed with double ligatures, have been passed at right angles to each other through the base of the tumor. The loop of each ligature being then cut, so as to form eight ends, two of them, 1 2, 3 4, 5 6, and 7 8, are to be tied firmly, so as to strangulate the tumor in four sections.

After Liston.

Fig. 2. A Comminuted Fracture of the Cranium, showing a small fragment removed by the forceps, and the elevator as passed into the opening thus made, so as to elevate the depressed portion of the skull. When a fracture is thus comminuted, the employment of Hey's saw across an angle of the fracture, or the application of the forceps, will often enable the surgeon to make room for the entrance of the elevator without employing the trephine. Whenever the latter instrument can be dispensed with, the danger of injuring the dura mater is much diminished. *After Bourgery and Jacob.*

Fig. 3. A view of the removal of a necrosed portion of the Parietal Bone, the integuments having been sufficiently dissected off from the head to permit the necrosed bone to be seized by the forceps and elevator.

After Bourgery and Jacob.

Fig. 4. Removal of a large tuberculated Exostosis from the posterior portion of the left parietal bone. The integuments have been everted by a crucial incision, and the tumor sawed through vertically. Hey's saw is seen in the act of removing it from the skull by cutting off its base.

After Bourgery and Jacob.

Fig. 5. A view of the Head of the patient operated on by M'Clellan, of Philadelphia, for a large spina ventosa of the cranium, showing the relative size of the incisions, and the depression left by its removal, as described in the text.

After M'Clellan.

Fig. 6. The cancellated appearance of the tumor when removed.

After M'Clellan.

Plate 6

Fig. 2

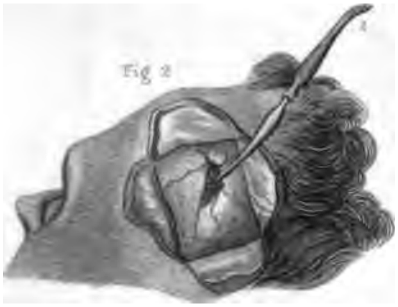


Fig. 1

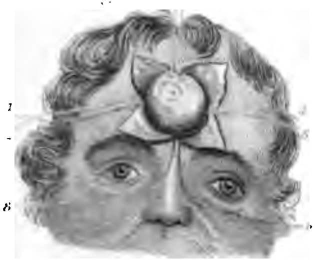


Fig. 5

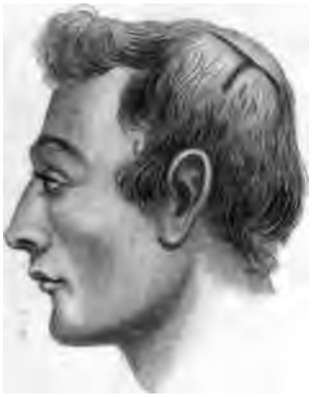


Fig. 4.

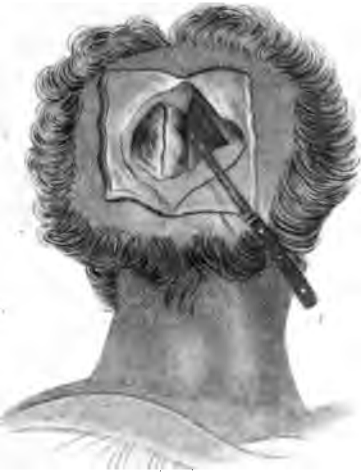


Fig.

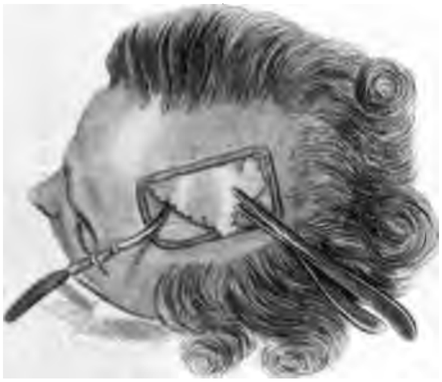
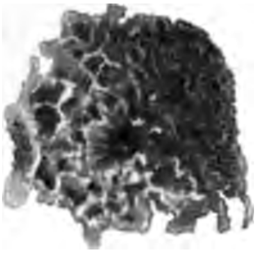


Fig. 6



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hemorrhage in proportion to its size, especially when the tumor is at all injured in the operation of extraction.

Treatment by Exciting Inflammation.—Vaccination, as suggested by the Germans, may be performed by introducing the vaccine virus into the tumor, as in the usual operation for protection from small-pox. The resulting inflammation has, in some instances, been quite severe, without terminating in a cure, and the practice is now seldom resorted to.

Heated Needles.—Bushe, of New York, induced obliteration of the vessels and sloughing of the diseased structure by introducing numerous needles—twenty or thirty—heated to a white heat, through different parts of the base of the tumor. Mott and others have also employed this method with success, as follows: The needles being heated to a white heat in the flame of a spirit-lamp, and then passed immediately through the base of the tumor, in various directions, should be quickly withdrawn, so as to cauterize the part and prevent any hemorrhage from the numerous punctures. The operation is said to be productive of but little pain, and to avoid the formation of a scar.

Caustic Threads.—N. R. Smith, of Baltimore, has frequently cured the disease by the following operation: Soak a thread in a saturated solution of caustic potash, and, after drying it at a fire, pass it through a needle; transfix the base of the tumor, and, leaving the thread in position, remove the needle. Pass several in the same manner, and the tumor will soon waste away without causing any troublesome symptoms.*

Seton.—Stevens, of New York, following the suggestion of Fawdington, of Manchester, of introducing a seton, has operated successfully by the following modification of his proceedings: A blunt-pointed needle, armed with several silk threads, being passed from one edge of the swelling, completely beneath it, to the other, the needle is withdrawn, and the silk thread left as a seton in the wound. No hemorrhage usually results, if the threads are sufficiently numerous to fill up the track of the needle; but suppuration ensues, and, in one case reported by John Watson, of New York, a cure followed, in which the cicatrix was only observable on minute examination.

Ligatures.—These means have been employed by Liston, Bell, White, Lawrence, and others, both in Europe and the United States, in various ways, so as to cut off the circulation from the base of the tumor by direct action upon its nutritious arteries; but if applied so as to include the skin, the ligatures are liable to cause intense pain and violent inflammation of the surrounding parts, and, in children, may even excite convulsions, or severe constitutional disturbance. To obviate these risks, it will be found advisable either to pass the threads around the base of the tumor by means of needles introduced immediately beneath the skin, as in the subcutaneous suture of Dieffenbach, or, when the skin is but slightly or not at all affected, to turn it back by a careful dissection, so as not to open the tumor; then passing two curved needles, armed with double ligatures, through the base of the tumor, cut off the loops of each thread and tie the eight ends together so as to strangulate it, and cause its removal by sloughing, Plate VI. Fig. 1.

Barton, of Philadelphia, operated successfully with the ligature, by passing two hare-lip pins at right angles to each other, through the base of the tumor, and then carrying a strong thread around them, and also across the top of the tumor, so as to strangulate all the portions included between the pins and the ligature; the object of the pins being to confine the ligature about the attachment of the tumor, as well as to compress its structure upon them.

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* American Journal of Medical Sciences, vol. vi. N. S. p. 260, 1843.

Brainard, of Chicago, has employed *Collodion*, in small tumors, and reported cases of cure. As a simple remedy acting by constricting the vessels, it may be resorted to in cases of a limited character. It should be applied to the surface of the skin over the tumor by means of a brush. In three cases I have recently obtained a cure by painting the surface of the tumor with a solution of corrosive sublimate four parts, in collodion thirty parts, as suggested by Mackay, of Edinburgh. In about six days the eschar drops off, when, if the structure has not sloughed out, it may be again touched. But, in small growths, one free application suffices. The ulcer heals readily under the water-dressing, or mucilage.

Excision.—A careful examination of many of these tumors having shown that they are not, in most instances, intimately connected with the surrounding parts, the practice of excision, as originally recommended by Bell, in England, and Physick, of Philadelphia, may be safely pursued when they are of moderate size, provided the incisions are kept in the healthy tissue. In their removal by excision, pass a needle and thick ligature through the tumor; tie its ends so as to form a loop and facilitate the elevation of the tumor from subjacent parts; then, making an elliptical incision around its base, dissect out the growth *without cutting into its structure*. In the scalp, the loss of integument and the hemorrhage will occasionally be an objection to this plan of treatment, especially if the tumor is large, and in these instances the following operation may be useful.

Partial Incisions Renewed at Intervals.—In a case of congenital angionoma, which covered nearly the whole of the right side of the head, Gibson, of Philadelphia, commenced its removal by making an incision around one-third of the base, taking up all the bleeding vessels as they were divided, and interposing lint between the edges of the wound so as to prevent the union of the integuments and the tumor at the point of incision; then, after an interval of a few days, he incised another third, secured the vessels, interposed lint in a similar manner, and, in a week afterward, removed the tumor.*

Physick, of Philadelphia, in a similar case, cut round the tumor, tied up the vessels as they sprung, suffered the parts to remain with lint interposed to prevent immediate union, and the tumor soon afterward wasted away.† In a few instances, ligature of the carotid arteries has been resorted to, and the tumors subsequently excised.

III. Aneurisms of the Scalp.—Dilatation of the blood-vessels of the scalp, and varicose enlargements, or large aneurisms by anastomosis, with other tumors, sometimes produce a condition of the vessels which, from its pulsation, resembles an aneurism, and which it is difficult to remedy by an operation, in consequence of the hemorrhage that ensues. In such cases, B. Dudley, of Kentucky, recommended compression by means of the common roller and properly adjusted compresses, and has succeeded in speedily curing cases of this kind in which the disease occupied one-half of one side of the head and forehead, and involved all the upper eyelid with the inner and outer canthus of the eye.

Estimate of these Methods of Operating.—In cases of angionoma where the skin is not much involved in the disease, or where the tumor is not larger than a walnut, or where the cicatrix would not create much deformity, excision will, I think, be found most prompt, and preferable to any other operation, the hemorrhage being, in most instances, according to my experience, readily controlled by ligature or by pressure, particularly when care is taken to incise only the healthy structure, and not to open the tumor; and there are few surgeons who have tried excision that have not preferred it to other means, particularly when they had proper assistants.

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* Dorsey's Surgery, vol. ii. p. 272, 1823.

† Op. citat., loc. cit.

John C. Warren, of Boston, long favored this operation, especially when the tumor was seated near the eyes, nose, mouth, or other natural apertures.* In his practice, three cases were treated by caustics applied externally so as to cause a slough, eight by ligature, and eighty-five by excision, all successfully.†

Where the tumor is very vascular and large, or so situated as to cause deformity by the cicatrix, the seton, as employed by Stevens and Watson, will be found to answer a good purpose; or cauterization by the heated needles may effect a cure, especially if the needles be made large. Vaccination is hardly worth the trial, unless in the hands of a timid practitioner. If the large size of the tumor should create just apprehensions of the hemorrhage likely to result from its prompt extirpation, the repeated operations of Physick and Gibson will, it is thought, answer better than the ligature of the carotids. In the cases reported by Mussey and Warren, the cure of large vascular tumors on the scalp did not ensue upon the ligature of the main arteries of the neck In the treatment of the smaller tumors, seen soon after birth, the application of corrosive sublimate will often suffice for the cure.

IV. Venous Tumors of the Scalp.—The veins of the scalp sometimes become enlarged, and present a varicose condition, which Fergusson, of London, has recommended should be treated by means of needles and pressure from ligatures, in the manner referred to in the treatment of varices of the leg. This condition of the veins of the scalp, independent of other complaints, must, however, be very rare, as I have never seen an instance of it during my attendance either in the United States or in the Parisian hospitals.

V. Cephalæmatoma.—Cephalæmatoma—*χεφαλη*, head; *αιμα*, blood—or the bloody tumors occasionally found on the heads of very young infants, may perhaps require the attention of the surgeon. These tumors have been divided by Valleix‡ into those in which the sanguineous collection is sub-aponeurotic, sub-pericranial, or sub-meningeal. These tumors differ, in position, from the bloody infiltration of the scalp, which is the result of a tedious labor, as this is most frequently seen near the vertex; whereas the common position of cephalæmatoma is the line near, but not at, the junction of the angle of the right parietal bone with its fellow. The sub-pericranial cephalæmatoma is the most common form, and demands prompt attention, in order to prevent such a separation of the pericranium from the bone as may result in caries or necrosis. These tumors are said, by Nélaton,§ to be most frequently seen immediately after birth in first children. Generally, nothing more is necessary for their cure than time and cold applications; but when the effusion is large, and likely to elevate the periosteum to any extent, it may become necessary to evacuate the clot in order to save the bone. Under these circumstances, a puncture which is merely sufficient to give exit to the blood, without admitting the entrance of air beneath the scalp, is all that is requisite. The reader who is desirous of more detailed information on the pathology of these tumors will be repaid by perusing the paper of Geddings, of Charleston.‖

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* Warren on Tumors, p. 461.

† Cooper's Surg. Dict.—Appendix by Reese, of New York, article Nævus.

‡ Maladies des Enfans.

§ Pathol. Chirurgical.

‖ In the North American Archives, vol. ii. p. 217.

VI. Division of the Supra-orbitar Nerve.—In some cases of injury of the forehead, and especially in contused wounds, the supra-orbitar nerve has become involved in the cicatrix, or given rise to such a neuromatous tumor as rendered the division of its trunk necessary, in order to relieve the neuralgic pain resulting from the condition referred to. In such cases the object may be easily accomplished by a subcutaneous section.

Operation.—In order to secure the division of the main trunk of the nerve, which is often superficial at its exit from the supra-orbitar foramen, the surgeon should introduce a sharp-pointed and narrow bistoury flatwise beneath the integuments, and close to the bone, on the external or temporal side of the foramen, passing it a few lines toward its inner side. Then, turning its edge toward the integuments and its back to the bone, let him divide all the tissues from behind forward until sensation is destroyed, taking care not to cut through the skin; then, turning the bistoury again flatwise, withdraw it at the point of entrance, closing the orifice immediately with adhesive plaster. Should a return of the disease lead to the suspicion of reunion in the nerve, a dissection and excision of a portion of its trunk may become necessary. Among the most decided cases of relief afforded by this operation are those reported by John C. Warren, of Boston,[*] who divided the three branches of the fifth pair many times with success. He has also operated on other nerves, in cases of severe neuralgia, especially in connection with those of the jaws and extremities, such as the infra-orbitar, submaxillary, and portio dura, all of which have been divided by him with marked relief to the neuralgic disorders of their branches.

§ 2.—Operations upon the Bones of the Cranium.

The operations practiced on the bones of the cranium are those required by diseases or injuries of one or both tables of the skull, such, for instance, as caries, necrosis, exostosis, fracture, or for the evacuation of bloody or serous effusions from within the cavity of the cranium. In the diagnosis or treatment of any of these affections, the operator will find it advantageous to shave the scalp at the point to be examined or operated on, so as to render the sensation given by the scalp less deceptive to the touch, as well as prevent the adhesion of the discharge and dressings to the hair. He should also have at hand one or more of the instruments referred to and shown in Plate V. In many cases, and especially when there is no wound at the part, he will find it necessary to incise the scalp; the incisions required under such circumstances being either in the form of an L, V, or ⌣, the last being the best, and so arranged that their dependent position may favor the escape of subsequent collections of pus.

I. Operations for Caries and Necrosis of the Cranium.—In operating upon the skull for either caries or necrosis, the bone should be sufficiently but not too freely exposed, by dissecting back the scalp to the necessary extent, and the same precepts be observed that are applicable to these diseases in the bones of the extremities, to wit, care taken not to remove the pericranium, or membrane covering the bone. After this, all the softened or dead structure should be thoroughly taken out, by means of the raspatory, saw, trephine, elevator, or forceps, Plate V. Figs. 14, 15, until the surrounding bone shows, by its color and vascularity, that it is capable of taking on healthy action, when the pericranium should be replaced, in order to favor the growth of new bone.

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[*] Boston Med. and Surg. Journal for 1825.

In operating for the removal of an enchondroma, exostosis, or other bony tumor of the cranium, the first incision should be so made through the integuments as freely to expose its base, and enable the operator to separate it from the skull with the saw, gouge, chisel, or cutting forceps, either by cutting through its centre down to its base, Plate VI. Fig. 4, or by exposing the base and then sawing through the tumor on a line with the general convexity of the head.

A remarkable case of "spina ventosa" of the cranium having been presented to M'Clellan, of Philadelphia, the following operation was practiced for its removal. The tumor was 4 inches in length, $3\frac{1}{4}$ inches in its short diameter, and about $1\frac{3}{4}$ inch above the surrounding portion of the skull.

Operation of M'Clellan.—The patient was a man twenty-two years of age, and had suffered from various symptoms connected with his head for three years; it was therefore decided to operate upon the tumor as follows: Two long incisions being made at right angles, and near the centre of the swelling, the scalp was dissected up from the whole surface, and to some extent around the sound bone. Then with a long, narrow saw, held at a tangent to the circumference of the cranium, the entire tumor was cut off at its base. The appearance of the cells of the tumor, and of the scalp subsequent to its removal, is shown in Plate VI. Figs. 6 and 5. Owing to the character of the tumor as thus shown, it was deemed necessary to remove the whole mass from the surface of the dura mater beneath it, which rendered the operation much more tedious and difficult, but which was accomplished by circumscribing the whole mass of the tumor by the circular edge of Hey's saw, and then prying it out in successive fragments, by means of an elevator, which was occasionally aided by the bone-nipper and forceps.* The dura mater, when exposed, had been so much depressed by the external development of the tumor as to present a deep cavity, capable of holding four ounces and a half. In removing some spicula of bone, this membrane was wounded, but the hemorrhage was arrested by pressure. Very little irritation ensued on the operation. In nine days, the compresses were loosened by suppuration, and, on removing them, the whole surface was found to be granulating, and an orifice which had been made in the longitudinal sinus was closed. The patient subsequently recovered, and his case, owing to the change in his mental disposition, attracted considerable attention from Combe and other phrenologists.

II. Trephining the Cranium.—As the brain fills accurately the cavity formed by the bones of the head, any cause which diminishes the space naturally occupied by this organ generally impairs its functions, and leads to a train of symptoms which may terminate life. To obviate these, and relieve the cerebrum from pressure, the operation of perforating the skull, so as either to restore its natural convexity or give exit to effusions within it, was suggested, and has been practiced since the times of Hippocrates, B.C. 460, the skull being perforated either by the trepan or by the trephine, and the operation named after the instrument which was employed to accomplish it, as **trepanning** or **trephining**.

The trephine is a circular saw, which is made to perforate the skull by frequently turning the hand from pronation to supination, the division of the bone by its application constituting the operation of trephining. The French surgeons of the present day, like those of the time of Hippocrates,† employ a somewhat similar saw, though it is one which, like the antique instrument, is fitted to a brace, and worked like a brace and bit. This instrument retains the old name of trepan—τρεπαω, I perforate—and the operation is hence called trepanning. The trephine differs from the trepan not so much in the shape of the saw, as in its being made to act by moving in a continuous circular course rather than in alternate semicircles, as is the case with the trepan. The sawing portion of the trephine is named the *crown*, in the middle of which is the *centre-pin*, or point to steady the saw in its first movements. This instrument is the one employed in the United States, whenever it is necessary to perforate the cranium; but the necessity for its use is less frequent at the present period than it was formerly, many of the older surgeons having deemed it right to trephine the skull in every possible affection of the head, whether due to a depressed fracture or not. As the trephine merely cuts an opening in the skull, the other instruments hereafter named will be required to elevate the bone or remove the detached portion.

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* M'Clellan's Principles and Practice of Surgery, p. 340.

† Hippocrates on Wounds of the Head, translated by Riollay. London, 1783.

When, from a depressed fracture or effusion of blood outside the dura mater, the brain is compressed, and the surgeon is satisfied that the removal of the compression will probably enable the brain to recover its functions, he may prepare for the operation as hereafter directed. In some cases of compression of the brain from a depressed fracture of the skull, the line of the fracture is such that cutting off an angle of the adjacent fragment by Hey's saw, or by a chisel or gouging forceps, will make a sufficient opening for the introduction of the elevator without resorting to the trephine.

As the propriety of trephining for the relief of disorders of the head is a point which it is difficult to settle, I would offer the following synopsis of the symptoms which have usually been deemed sufficient to justify the operation:—

It is generally proper to trephine, or otherwise open the cranium, when marked evidence of a depressed fracture and of compression of the brain is present. If the depressed bone can be distinctly felt or seen through a wound in the scalp, and there is yet no evidence of compression of the brain, the patient should be carefully watched, and the operation only resorted to when the evidence of disorder from the depressed bone is positive.

The propriety of trephining, under any circumstances, is, however, a question on which surgeons have long differed, some trephining in every case of unconsciousness, and others limiting the operation to cases of marked compression. Without presuming to suppose that any individual opinion can settle this vexed question, I only offer the expression of my own experience as favorable to the performance of the operation in all cases of compression due to a depressed fracture, as well as to cases of epilepsy consequent on such injuries, when the depression can be recognized, though the recent experience of military surgeons is evidence against the propriety of the operation, as will be stated after the description of the operation.

Preparation for the Operation.—1st. Shave the patient's head around the seat of the injury, and arrange the instruments upon a board or tray in the order in which they are designated, or in that in which the operator thinks they may be required. 2d. Place the patient so that his head may be readily acted on without the operator stooping too much; take care, also, that the bed or table is not too high, as this may likewise create difficulty, and fatigue the surgeon in the manipulation of his instruments.

Ordinary Operation.—If the scalp is uninjured, and an incision is required in order to expose the bone, it should be made by dividing the scalp either in a crescentic form, as advised by Pott and Velpeau, or in that which is V-shaped or crucial +, as recommended by Physick, in order that the part upon which it is proposed to operate may be left bare, the flaps being dissected *with the pericranium*, that the latter may be replaced again. Should a wound already exist, it may be enlarged to the necessary extent without making an incision of the shape above described. Having thus exposed the bone, the trephine should be taken in the right hand, with the centre-pin projecting, and held, as seen in Plate VII. Fig. 3, that the crown can be applied either upon the edge of the depressed bone, or sufficiently near to permit of its being raised by the elevator, when inserted through the opening cut by the trephine. Then turning the hand steadily and slowly from pronation to supination, and pressing firmly upon the handle so as to cause the saw to cut itself a track in the outer table, make a few turns; remove the instrument, draw up or take out the centre-pin, test the depth of the track of the saw with a tooth-pick, and, reapplying the instrument, renew the sawing until the diploë is reached. This structure, if well developed, may often be recognized by the bloody character of the sawdust, or by the more free action of the saw, though the absence of either is no sign that the trephine has not entered the diploic structure of the skull, as it is sometimes but sparsely developed. After testing again the depth of the track, saw cautiously, examining the state of the furrow from time to time, until the skull is perforated, or nearly so, the latter being told by gently acting in the furrow with the forceps or lever, and endeavoring to raise the piece. When the disk is found to be sufficiently free, it may be either pried out with the elevator or removed with the forceps, or it may come away in the crown of the trephine without any special effort being made for its removal. On removing the disk of bone, the dura mater will be seen perfectly exposed, and if the case is a depressed fracture, the operator may introduce the elevator very cautiously between this membrane and the cranium, and, keeping the point of the instrument close to the latter, use the thumb or the sound part of the adjoining bone as a fulcrum, so as to elevate the fractured portion to its proper level, taking care to mould it to its former convexity by pressing with the fingers upon the outside of the skull. If, on perforating the bones, blood is found to be effused outside of the dura mater, careful manipulation will enable the operator to turn it out without injuring the membrane, as this is generally depressed and separated from the inner table of the skull by the effusion. If, however, the blood is evidently beneath the membrane, it may be questionable whether the danger from its puncture is not greater than that which would ensue if the effusion were left to nature. The judgment of the surgeon, based upon the urgent character of the symptoms, can alone decide this point. Patients have recovered when the membrane has been punctured and even considerably lacerated; yet no judicious operator would deem such a result a precedent, except in cases of great emergency.

If, in the application of the trephine, any of the blood-vessels of the dura mater are accidentally cut, the bleeding may be checked by pressure, or by ligature, as was done by Dorsey, of Philadelphia, in a case in which hemorrhage from a wound in the superior longitudinal sinus was so free as to demand the application of a dossil of lint, or by applying a ligature to the wounded vessel, as was done in a wound of the middle artery of the dura mater, by F. Dorsey, of Maryland.*

Hemorrhage from the same artery, which was deeply imbedded in its channel in the bone, was also arrested by Mütter, by plugging the vessel in its bony canal with a small piece of soft wood, as recommended by Physick. Bleeding from the integuments may be readily checked by a needle and ligature, or by the latter applied in the usual manner with the tenaculum.

Dressing.—After the perforation has been completed, the parts should be cleansed, the flap, including the pericranium, neatly applied over the opening, and retained in position by a compress of lint thoroughly saturated

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* Dorsey's Surgery, by Randolph, vol. i. p. 323, 1823.

PLATE VII.

A VIEW OF THE STRUCTURE OF THE HEAD AND OF THE OPERATION OF TREPHINING.

Fig. 1. A side view of a lateral section of the head, showing the relations of the scalp, skull, and brain, with its blood-vessels. 1. The scalp, after the hair has been shorn. 2. The tendon of the occipito-frontalis muscle. 3. The divided edge of the bone, showing the outer and inner tables, and the diploic structure. 4. The shining surface of the dura mater. 5, 5, 5. The superior longitudinal sinus, extending from the cristi galli to the Torcular Herophili. 6. The middle artery of the dura mater, where it first passes on to the vault of the cranium. 7. Its anterior branch. 8. Its posterior branch. 9, 9. The lateral sinus of the dura mater in its course along the occipital and temporal bones to empty into the internal jugular vein. *After Bernard and Huette.*

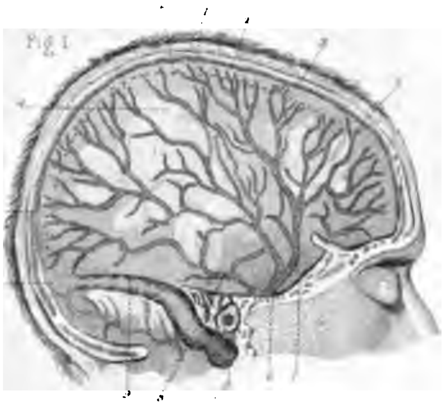
Fig. 2. A view of a stellated and depressed Fracture of the Cranium, showing the point at which the perforation of a trephine should be made, so as to elevate the depressed portion. 1. Point of perforation of the trephine. 2. The depressed portion of the skull. *After Bell.*

Fig. 3. A lateral view of the operation of Trephining, as practiced on the right parietal bone. The patient is represented as comatose from a depressed fracture, and lies with his head firmly supported and steadied on a hard pillow placed well under the neck. The integuments over the depressed portion have been incised and dissected back sufficiently far to expose the fracture, while the surgeon, holding the handle of the trephine firmly against his palm, and with the forefinger extended upon its shaft, is just commencing to pronate and supinate his hand so as to work the crown of the instrument and cause it to excise a portion of the skull sufficient for the introduction of the elevator, or the evacuation of the clot. *Drawn from Nature.*

Fig. 4. View of the position of the Lenticular Knife, as employed in removing any spicula left on the internal table of the skull after the use of the trephine. 1. Position of the hand in using the lenticular.

After Bernard and Huette.

Fig. 1



[illegible]

Fig. 2

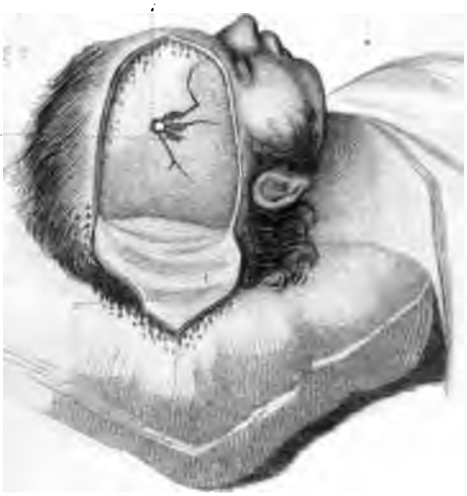
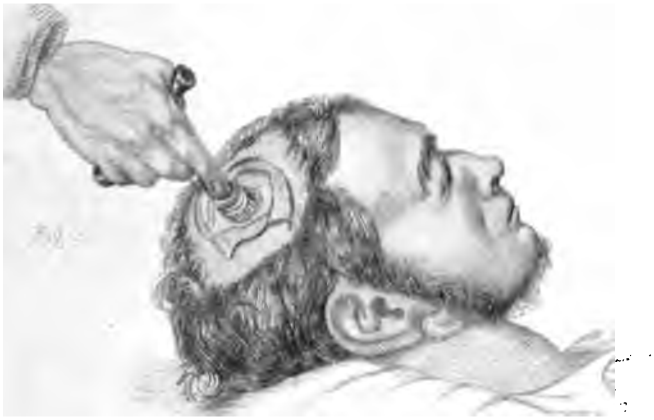


Fig. 3



[illegible]

with tepid water, the water-dressing being applied so as to favor union, care, however, being taken to secure the free exit of pus, should any form beneath the integuments, and attention given to any signs of meningeal inflammation. In all cases the strictest diet should be rigidly observed until the risk of inflammation has passed away. After recovery, the head may be protected, if the individual is exposed to injury, by using a thick-crowned hat for several months, or until fibrous or osseous matter closes the perforation in the bone. The popular idea of closing the opening in the skull by a silver plate doubtless had its origin in the application, outside the scalp, of a protecting bandage; but a thick hat answers every purpose.

Remarks.—The propriety or impropriety of trephining, in cases of injury or other disorders of the head, is, as has been previously stated, a question which at all times has had able advocates on both sides. That the application of the trephine was at one period unnecessarily resorted to, cannot be doubted, as we find that it was employed in cases of concussion of the brain, under the idea that blood was effused at particular points of the head, merely because the bone was discolored or seemed too vascular. Though the result of such practice has been to throw doubt upon the utility of the operation, there can be no question that evil has also ensued from the opposite extreme, patients having been permitted to die when the application of the trephine might have saved them. Judgment is therefore necessary in order to prevent the misapplication of this, as of many other useful remedies. In some instances, the relief afforded by the application of the trephine has been very prompt, and in a case reported by Quintard, of Georgia, the elevation of the depressed bone gave instantaneous relief from insensibility, loss of power, etc. Dudley,* of Kentucky, has also reported numerous cases of prompt relief from epileptic symptoms which followed the removal of a spicula, or of a depressed bone; and Holston, of Ohio, has likewise reported numerous similar cases.† Harden, of Louisville, is so well satisfied of the advantages of trephining in most cases that he proposes, at the close of an account of numerous cases,‡ the following rule: "That in every clearly ascertained fracture of the cranium with depression, the bones should be elevated or removed, whether there be a scalp wound or not." There are, however, some surgeons who doubt the propriety of perforating the skull by a trephine, preferring other instruments. Thus Goldsmith, of Louisville, objects§ to the use of the trephine, advising, as safer and less destructive of the skull, the removal of a fragment by means of a chisel Others, again, prefer cutting out a portion by gouge-like forceps. Goldsmith has especially advocated the value of preserving and replacing the pericranium.

Statistics.—The following table of cases, collected from various sources, shows the number of cases trephined and of those not trephined, with the comparative results of each plan of treatment, although nothing is said of the peculiarities of either set of cases, a fact which must always aid in the decision of the operation:—

Cases.	Trephined.	Cured.	Died.	
77	51	11	40	Laurie and King.
Not stated	42	28	14	H. H. Smith.
Not stated	45	11	34	Lente, N. Y.
	138	50	88	

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* Transact. of Med. Society of Georgia. Report of Committee on Surgery.

† Bibliography, p. 62.

‡ Western Journ. of Med. and Surg., vol. ix. p. 203, 1852.

§ Louisville Med. Journ., vol. i. No. II. 1860.

Laurie and King also present the following:—

Cases.	Not trephined.	Recovered.	Died.
77	26	18	8

Whether the latter injuries were more serious than those reported by them in the former statement is not mentioned.

Lente,* of New York, who has furnished a most elaborate account of 128 cases of severe fractures, as presented in the New York Hospital, and a portion of which is included in the above numbers, has arrived at the following results:—

Out of 128 cases of fracture of the skull, 106 died. This extraordinary mortality he regards as due to the violent character of the accidents which caused the fracture; yet we notice that in 45 of these bad cases, about one-fourth of those trephined recovered, and that out of the 22 recoveries, one-half were trephined successfully. The operation was performed *prophylactically* in ten, of which three were cured; and *therapeutically* in 32, of which eight were cured.

In 26 or 26·31 per cent of all his cases, both the brain and its membranes were lacerated. In ten there was hernia cerebri, of which only two recovered. In twelve cases, where the symptoms of compression were well marked, the patients not being in immediate danger of death, the pupils were *dilated* in ten, contracted in *two*.

In five cases of those trephined, an incision was made in the dura mater—none of these recovered.

Although these statistics are far from perfect, yet they tend to show that in fractures of the skull met with in civil hospitals, and attended with symptoms of compression, the operation of trephining affords a better chance of recovery than leaving the case without an operation. The different opinions of military surgeons has been already given in connection with wounds of the head.†

In epilepsy, trephining has been followed by some success, and the performance of the operation in well-marked cases has sometimes been attended with the happiest results. Of fourteen cases that I have collected of the operation in this complaint, all were reported cured but one.

It may therefore be assumed, as a general rule, that trephining, or the removal of depressed portions of bone by any instrument that will readily accomplish it, may be advantageous in civil hospitals under the following circumstances:—

1st. In bad compound fractures, where the depression can be seen, and the symptoms of compression are well marked.

2d. In simple fractures, where the depression is positively felt, and similar symptoms exist.

3d. In bad compound fissures of the cranium, accompanied by free hemorrhage from within the skull, and attended with symptoms of compression.

But the necessity of puncturing the dura mater in any case should always induce an unfavorable prognosis, or a very guarded one.

In view of the variety of opinions, it will be well, in every case that it is proposed to operate on, to explain to the patient's friends the serious character of the accident, and the fatal tendency of the injury, whether operated on or left to nature.

III. Trephining the Frontal Sinus.—*Operation.*—In the rare cases in which it may be deemed necessary to apply a trephine upon the frontal sinus, the operator should proceed precisely as in the application of the instrument upon the vault of the cranium, recollecting, however, that an opening in the outer table of the skull, which at this point is often quite thin, is all that is necessary.

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* New York Med. Journ., vol. viii. p. 29.

† Vol. i. p. 483.

IV. Puncturing the Head for Hydrocephalus.—An effusion of serum within the ventricles of the brain, or in its membranes, being usually the result of serious organic disease, but little benefit can be anticipated from an operation that simply looks to the removal of the effect, instead of the cause, of the difficulty. When, however, medical treatment has failed, tapping the head for the removal of the fluid may be deemed worthy of trial, as a last resort, and with a view of prolonging life, although the *post-mortem* examinations in most instances have shown that the cerebral structure was so much diseased as to leave but little reason to anticipate the general adoption of this operation. In the United States, it has been performed by Physick,* of Philadelphia, by Glover, of Charleston,† by L. A. Dugas, of Georgia, and by J. B. Whitridge, of South Carolina, and many others.‡ Dugas tapped his patient seven times, and drew off sixty-three ounces of liquid, the patient living from June 25th to October 18th. When the effect of the heat of the summer upon children is recollected, it will doubtless be admitted that life was prolonged in this case beyond what might have been anticipated. In the case of Whitridge, the child lived from August 31st to October 31st ensuing. Accounts of cures effected by tapping are also reported as performed by James Vose, of Liverpool,§ by Conquest, of England,‖ by West,¶ though I have not been able to examine the latter paper. In one case reported by Conquest, the number of operations performed on it was five, at intervals of from two to six weeks, and the total amount withdrawn was about fifty-eight ounces. Conquest also appears to have had marked success in his operations, having ten patients to live out of nineteen operated on.** Of sixty-three cases, carefully collected from different authors, and reported by West, of England,†† not more than two out of seven recovered; six dying within four days, and only one surviving six months.

Ordinary Operation.—Introduce a needle and canula, or a fine trocar, as advised by Conquest, at the frontal suture, midway between the crista galli and the anterior fontanel, or at any point of the fontanel or other opening in the head not likely to interfere with the corpus striatum or the sinuses, and carry it deep enough to reach the cavity containing the fluid, as may be told by the want of resistance at the point of the instrument. This will most frequently be found to be before the trocar has penetrated two inches. Then, after allowing the fluid to escape through the canula slowly and cautiously, make moderate compression upon the cranium either by the turns of a roller or by strips of adhesive plaster tightly applied, as advised by Blane and others. It may, I think, be doubted whether, as a general rule, there is any advantage in compressing the skull from the commencement of the operation, as has sometimes been done, as the distended condition of the brain will generally suffice to force out the liquid with sufficient rapidity, while the gradual evacuation, by enabling the skull to adapt itself to the diminished size of its contents, will obviate the evils sometimes seen if compression is not accurately preserved. Various obstacles may present themselves during this operation, such as the sudden arrest of the flow of the serum from a small particle clogging the canula, or the hemorrhage of a vein, or faintness, or convulsions, for all which the surgeon should be prepared; thus the introduction of a probe will soon clear the canula, a little time check the hemorrhage, faintness be obviated by lowering the head and applying ammonia to the nostrils, and the convulsions often cease when the escape of the fluid is checked by placing the finger over the canula. If, however, the operation is conducted as advised by Physick, of Philadelphia, without compressing the head—that is, by allowing the fluid to escape slowly through a small canula, and simply by the contraction of the natural tissues, until it ceases to flow freely—the pressure from the fluid within the brain will be so gradually removed that the application of moderate external pressure will more than compensate for its disappearance. In all cases when a bandage is applied to a cavity containing liquid at the moment of its being punctured, the pressure, according to the views of Physick, evacuates the fluid so rapidly as to create a marked change in the relation of the parts, which is not the case when its escape is due solely to vital contractility, and, in the case of a brain which has been much distended, may be quite sufficient to destroy its function. Compression of the head during the operation has, however, been strongly urged by Conquest, and his success has certainly been very marked. After a sufficient amount of the liquid has been evacuated—as indicated by the pulse—the puncture should be closed, the bandage applied and kept accurately adjusted, and a proper medical treatment persevered in.

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* Philadelphia Medical Journal, vol. iv. p. 216. † Ibid. p. 403.

‡ Am. Journ. Med. Sciences, vol. xx. p. 536, 1837.

§ Medico-Chirurgical Transactions, vol. ix. ‖ Lond. Med. Gazette, March, 1838.

¶ In the same journal, April, 1842; as well as in the Bulletin Gén. de Thérapeutique, vol. xxiii.

** London Medical Gazette, March, 1838. †† Ibid. vol. ii. April, 1842.

As the subject of Paracentesis Capitis has recently excited some attention, I cite the following case as an additional illustration of the character of these operations:—

Operation of Peace, of Philadelphia.—Marked disease of the brain having apparently commenced soon (three days) after birth in the child of a healthy woman, and the senses being nearly destroyed, it was determined, as the child was now seventeen months old, and must certainly sink under the continued progress of the disorder, to attempt its relief by paracentesis capitis, which was done as follows:—

Operation.—A small silver canula, armed with a grooved trocar, being introduced about one inch to the right of the longitudinal sinus, and half an inch from the superior margin of the os frontis, the trocar was removed and followed by a jet of limpid serum, which continued to flow until about twenty ounces were evacuated, moderate pressure being maintained upon the head during the operation by the hands of assistants. After the evacuation of this amount and the removal of the canula, a pledget of dry lint was applied to the puncture, and lightly secured by a strip of adhesive plaster; after which the whole head was permanently compressed by broad strips of plaster, so applied as to envelop it completely. Soon after the operation, the pulse was good, and the child took the breast with avidity, no untoward symptom supervening until the fourth day after the operation, when it became more restless, with increased heat of head, etc., and died on the sixth day. A considerable amount of serum continued to flow from the puncture throughout this period of six days. A *post-mortem* examination showed that the hemispheres of the brain had been distended into mere sacs, and that the ventricles still contained about four pints of turbid serum. The whole amount effused was calculated to have been eight pints and four ounces.

Among other measures which have been tried in these almost hopeless cases, and especially in those which are chronic, is the injection of iodine, as suggested by Velpeau in diseases of the serous cavities generally. Brainard, of Chicago, when trying this method, employed a solution of iodine gr.

$\frac{1}{12}$th; iodide of potash gr. $\frac{1}{8}$th; water f℥ss; gradually increased to iodine grs. xii; iodid. potas. grs. xxxvi, and water ℥j; all of which was injected, and with apparent benefit at the time of the report.* But further experience in its use is necessary, though analogy seems to present some probability of success. As the operation of paracentesis has as yet presented but little to encourage surgeons in its repetition, it may be well to try the effect of long-continued and gentle pressure by means of bandages or adhesive strips, as advised by Barnard, of England.

V. Removal of Fungoid Tumors of the Dura Mater.—The development of fungoid tumors upon the dura mater sometimes leads to the absorption of both tables of the skull, and the appearance of the fungous growth directly beneath the integuments. From the nature of the parts involved, and from the observation of the cases, many surgeons have regarded this disease as hopeless; but as successful operations have been performed, and as the result of *post-mortem* examinations has often shown that the disease is frequently limited to the dura mater, or rather does not encroach upon the brain, the propriety of operating under even these dangerous circumstances is a question which the operator must decide for himself at the moment. Among the cases reported, one out of three of this apparently hopeless operation has succeeded, and the surgeon may therefore deem a repetition of it advisable, although his prognosis should be guarded. In a case reported by J. C. Warren, of Boston,† a lady, twenty-two years of age, in 1846 had a tumor on the right side of the forehead and right temple, which had shown itself the preceding year. The tumor was smooth, uniform in its appearance, diffused in the surrounding parts, had no distinct boundary, was not discolored, somewhat elastic, not painful nor tender, and never had been. Nothing like a depression could be discovered in the central part. In 1847 the skin became ulcerated, and a fungus about the size of an egg showed itself. This was of a red color, without sensation to the touch, without pain or intellectual disturbance when pressed on, bled readily, and a probe penetrated the substance of the tumor to the depth of three inches, yet the patient recovered. The operation was performed as follows:—

Operation of John C. Warren, of Boston.—An incision being made on four sides of the tumor, so as to make four flaps of the skin, the latter were separated from the fungous mass as exactly as possible; the soft and cerebriform matter cut away in detached portions, the disease traced through an irregular opening in the bone to the dura mater, and the actual cautery applied freely to the surface. The hemorrhage, which was great, was suppressed by two or three ligatures and the cautery, and the subsequent symptoms were of a favorable character. The wound healed slowly, but after some months closed entirely; has remained well ever since, and the patient has had no unpleasant feelings in her head, or any other symptoms of disease. As the case was witnessed by a great number of medical gentlemen, there can be no doubt as to the character of the disease.

In a previous case, in which the disease developed itself in a young man, it returned after removal, and caused death.

In the case of a lady operated on in the Massachusetts General Hospital in 1828, the disease also returned, but the patient did not die until two years after the operation.‡

S. D. Gross, of Philadelphia, has published§ the history of a case which, in the hands of Jas. C. Johnson, formerly of Louisville, fully illustrates the fact that these cases frequently present examples of great tolerance of injury, and that operations upon them are not necessarily and promptly fatal. In this case, an old gentleman, after suffering excruciating pain for some time, was found to have on the top of his head a hard, firm, immovable, and indolent tumor, about the size of a pigeon's egg, which increased and became soft and pulsating, inducing the belief that it was aneurismal. An operation being decided on, a crucial incision three inches long denuded the tumor, which, on being disengaged from its attachment to the periosteum and dura mater, and elevated from its bed on the skull, was found to leave the latter perforated to the extent of about a quarter of a dollar in diameter. The hemorrhage, which was slight, was arrested, and the wound dressed in the usual manner with adhesive strips, a compress, and bandage. On removing the dressings on the eighth day, the tumor was found to be again springing up, rapidly acquired the size of a hen's egg, and was pedunculated. It was now excised a second time, but the hemorrhage was so profuse as to create apprehension. This being checked, the tumor reappeared in another fortnight, and was treated, by the advice of Dudley, by a sponge, compress, and adhesive strips long enough to reach from one side of the head to the other. The tumor, after being thus checked, again sprouted, and was treated by nitrate of silver, butter of antimony, the knife, and actual cautery, with but little benefit. Eighteen months subsequent to the first operation, an empiric, by caustics, removed the entire mass, until a cavity was left in the brain "capable of receiving a common-sized teacup." Many pieces of bone having come away, the destruction of the cranium had reached three inches in diameter. This patient now traveled a long distance, and did not die until nearly two years after the first notice of the tumor, no disorder of the brain having been indicated at any moment. No *post mortem* was permitted, but a manual examination indicated the presence of stalactiforme exostosis, etc.

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* Transact. Am. Med. Assoc. for 1850, p. 371.

† Ibid. p. 403.

‡ Warren on Tumors, p. 510.

§ History of Kentucky Surgery, p. 60, 1853.

In a case which I saw some time since, the *post-mortem* examination clearly showed that though the tumor sprang from the dura mater, and by pressure on the compact matter of the skull had expanded its fibres so as to form a spina-ventosa like tumor, yet the under surface of the dura mater was not depressed by the tumor, and that the latter might, therefore, have been removed without causing any greater injury to the brain than that resulting from the application of a trephine.

Remarks.—Although the character of these fungous tumors of the dura mater has long been well known, having been thoroughly described by Louis,* Abernethy, and others, all of whom entertained the opinion that they originated from the dura mater, or in the bones of the cranium, yet few surgeons have deemed it advisable to recommend an operation for their relief. Velpeau, however, in an able article upon the complaint,† states that, in his opinion, "extirpation is indicated in these cases of fungous tumors of the head as well as in those situated elsewhere, but that they, like other forms of cancer, also present contraindications." From reviewing the opinion expressed by him, in the article referred to, as well as from the results of my own experience, it may, I think, be assumed as a rule that, if the operation can be thoroughly performed without excessive loss of blood, the chances of the return of the disease and the ultimate cure of the patient may be placed on a par with the operations for cancerous developments in other portions of the body. In four cases which it has fallen to my lot to witness, the *post-mortem* examination of two not operated on satisfied me that the disease had progressed from the outer lamina of the dura mater toward the scalp, but had not encroached on the brain. In the other two cases, though the tumors were moderately developed, no operation was deemed advisable, and the subsequent result is unknown; but when last seen, one was rapidly progressing to ulceration. I would therefore feel disposed to attempt the removal of these tumors by the knife, or rather by it and the use of caustic potash, in such cases as would justify any one in operating for a malignant disease generally.

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* Mémoires de l'Acad. de Chirurgie, tome vi. p. 361, edit. Fossone, 1837.

† Dictionnaire de Médecine, tome x. p. 532. Paris, 1835.

CHAPTER II.

DISORDERS AND OPERATIONS CONNECTED WITH THE FACE.

THE Face, as a region, being composed of various sub-regions, as the eyes, nose, and mouth, their disorders, as well as the operations required for their relief, will be treated of under special heads after a brief anatomical description of each of the portions concerned.

SECTION I.

SURGICAL ANATOMY OF THE FACE.

The **Face**, as a surgical region, is bounded by the superciliary ridges above, by the base of the inferior maxilla below, and is formed by the superior maxillary, inferior maxillary, malar, nasal, palate, and ethmoid bones, together with those of the vomer and inferior turbinated. Its external portion is composed of the skin, muscles, vessels, and nerves.

The skin of the face presents nothing of direct interest to the surgeon. Its sebaceous follicles, especially upon the nose, are the occasional seat of tumors, which require the ordinary elliptical or crucial incisions for their removal. When any tumor upon the face is so situated that its removal will leave a wound in a very movable portion of the integuments, the use of a stitch or two of the interrupted metallic suture will, as a general rule, prove to be a better means of uniting its edges than the employment of adhesive plaster.

In all operations upon the integuments of the face, attention should be always given to the line of the incision, in order that the cicatrix may be brought as much as possible within the folds created by the action of the subjacent muscles, the levatores anguli oris, zygomatici, and buccinators being those which are chiefly interested.

The action of the levator anguli oris and of the buccinator muscles should also be recollected in the operations for hare-lip, their contraction being the main cause of the difficulty experienced in uniting the wound after the operation.

The vessels of the face are principally branches of the facial arteries and veins, hemorrhage from which may be easily checked by compression at the point where the artery passes over the jaw, or by leaving the wound open to the air for a few minutes. Should this not suffice, then the ligature may be employed; but it is better to avoid this if possible, as the union is more perfect, and the scar less apparent subsequently. The nerves that supply the face are branches of the second branch of the fifth pair coming out at the infra-orbitar foramen, or branches of the seventh pair, or portio dura, which, emerging at the stylo-mastoid foramen, are distributed to most of the muscles. The division of the main trunks of either of these nerves, in removing tumors or other operations upon the face, is apt to cause distortion of the features or loss of sensibility, though, in some few cases, the subsequent healing of the parts has restored the motion and sensation of the portion whose supply had been involved in the operation. But, in nearly every instance, as any deep incision must necessarily divide some portions of the nerves of the part, the surgeon can do little more than bear in mind the importance of avoiding them, if possible, or at least of not excising their trunks if they should be divided, as union may possibly restore their function.

The Face is subdivided into the regions of the eyes, nose, and mouth, the anatomical details of which may be briefly referred to before mentioning the disorders and the operations practiced for their relief.

§ 1.—Anatomy of the Appendages of the Eye.

The **Appendages** of the eye consist of the lids and the lachrymal apparatus.

The lids are composed of a thin, delicate skin, in which are numerous horizontal folds; of a loose and very movable connective tissue, which latter is often the seat of encysted tumors; of a layer of circular muscular fibres, the orbicularis palpebrarum, and on the upper lid of a vertical muscle, the levator palpebræ, which together create the folds of the skin just referred to; and of two tarsal cartilages, which are thick upon the margin of the lids, thinner at the distance of a few lines, intermediate to the muscle and the conjunctiva, and beveled on their margin so as to secure a gutter for the tears. The cartilages tend to prevent the puckering of the lids, which would otherwise ensue upon the contractions of the orbicularis muscle. The levator palpebræ muscle is situated in the upper lid between the orbicularis and the cartilage; arising near the optic foramen, it is attached to the edge of the cartilage near its middle. The tensor tarsi muscle of Horner arises from the posterior superior part of the os unguis, just in advance of the vertical suture between the os planum and the os unguis. Having advanced three lines, it bifurcates, one bifurcation being inserted upon the upper lachrymal duct and terminating at its junction or near it, while the lower bifurcation has the same relation to the lower lachrymal duct. The base of the caruncula lachrymalis is placed in the angle of the bifurcation. Its use is to draw the orbital portion of the lachrymal sac away from the nasal portion and thus dilate the sac.* The external tensor muscle of Mosely† is a small muscle that runs parallel to the abducens arising from the orbital surface of the malar bone; anterior to its union with the orbital face of the sphenoid, it runs forward, its tendon blending with the fibrous tissue at the outer angle of the eyelid. When tense, this muscle draws the external canthus outward and backward, antagonizing the tensor tarsi Horneri. These two muscles play an important part in keeping the cartilages applied against the ball. The conjunctiva or mucous coat of the eyeball is the last layer of the lids. It is reflected from the ball over the posterior face of the lids as far as the edge of the cartilages, and by its character as a mucous membrane favors the motion of the lid upon the eyeball. Between this membrane and the cartilages lie the Meibomian glands, or the tortuous canals which open upon the edge of the cartilage, and lubricate its surface, thus preventing the escape of the tears over the lids, and also facilitating their passage along the grooved edge of the cartilages to the puncta lachrymalia or openings of the lachrymal ducts found in the cartilages near the internal canthus of the eye. The cartilages are attached at the internal canthus to the internal palpebral ligament, which is also the point of origin of the fibres of the orbicularis palpebrarum muscle. Rendering this ligament tense by stretching the lids toward the external canthus, furnishes a guide for the point of puncture in opening the lachrymal sac in epiphora or fistula lachrymalis, if the swelling be not too great.

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* Horner's Special Anatomy, vol ii. p. 398. Phila. 1851.

† Bost. Med. and Surg. Journ., vol. xlix. No. 1, p. 16, August, 1853.

§ 2.—Anatomy of the Lachrymal Apparatus.

The **Lachrymal Apparatus** consists of the lachrymal gland which secretes the tears, of the puncta lachrymalia which receive them, and of the canals which conduct them into the nose.

The lachrymal gland—Plate XI. Fig. 1—is placed immediately below and within the external angular process of the frontal bone. Its secretion is emptied upon the eyeball by seven or eight ducts which lie between the conjunctiva and the cartilage of the upper lid. It lubricates the part, facilitates the motion of the lids, and washes off small foreign particles as dust, etc., accidentally introduced between the lid and the ball, or upon the ball. The course of the tears toward the puncta lachrymalia generally carries such matter to the internal canthus.

The puncta lachrymalia or openings of the canaliculi lachrymales are found bordering on the internal end of the upper and lower tarsal cartilages, but are distinct from it. The upper punctum looks downward and the lower points upward, and each in the ordinary condition of the parts will admit a bristle. The lachrymal canals or ducts are situated immediately beneath the skin at the internal canthus of the eyelids, in their posterior margins, and behind the orbicularis muscle. One is found in each eyelid, and is about half an inch long, the lower being rather the larger. In each lid the canals run perpendicularly at first upward and downward from the free edge of the lid for about two lines, after which they converge and enter the lachrymal sac behind the internal palpebral ligament. Stretching or elongating the lids outwardly toward the temple will generally remove the angular commencement of the canals, and favor the passage of a fine probe into the saccus lachrymalis.

The lachrymal sac—Plate XI. Fig. 1—is an oblong cylindrical cavity, or enlargement of the ductus ad nasum, situated in the depression of the os unguis and of the upper part of the same depression found in the nasal process of the superior maxillary bone. It is covered in front by the ligamentum palpebrale, as well as by a few fibres of the orbicularis muscle. The course of the sac is first slightly forward and from above downward, but from the level of the orbit it passes obliquely backward at an obtuse angle with its course at first. It decreases as it descends, and below the edge of the tendon constitutes the lining of the bony ductus ad nasum, and is sometimes designated simply as the nasal duct. It is composed of two layers, an external fibrous one, continuous with the periosteum, and an internal mucous membrane which is continued from the puncta or even the conjunctiva, into the Schneiderian membrane. On a line with the floor of the orbit there is a doubling or valve formed in the membrane, and occasionally there is another at the nasal orifice formed by the Schneiderian membrane.

The position of these folds is certainly an objection to the introduction of sounds, from the nostril, into the ductus ad nasum, as recommended by Laforest. The length of the duct varies in different subjects, being on an average fifteen lines, and its inferior orifice is pretty regularly found beneath

PLATE VIII.

EYE INSTRUMENTS.

Fig. 1. Desmarres's Bifurcated Forceps, for holding the skin during the passage of a suture. *After Bernard and Huette.*

Fig. 2. Charriere's modification of Adams's Forceps. *After Bernard and Huette.*

Fig. 3. Desmarres's Forceps, for holding the upper eyelid during the removal of little encysted tumors. *After Bernard and Huette.*

Fig. 4. Charriere's Rat-tooth Forceps. " " " "

Fig. 5. Charriere's Curved-pointed Forceps. " " " "

Fig. 6. Physick's Forceps, for perforating the iris in the formation of an artificial pupil—one end is a flattened plate and the other a punch, the iris being cut by closing the blades. *From the instrument.*

Fig. 7. Fine-teethed Forceps, for pterygium. *After Bernard and Huette.*

Fig. 8. Self-acting Speculum of Ruschenberger and Goddard; the lower bar moves on the shaft, and is capable of resisting the contraction of the lids. With this instrument no assistant is necessary. *Kolbè's pattern.*

Fig. 9. A Silver Spring Speculum. " "

Fig. 10. Anel's Syringe. " "

Figs. 11, 12. Anel's Points, adapted to the syringe, when injecting the puncta lachrymalia. *Kolbè's pattern.*

Figs. 13, 14. Front and side view of Ware's style for fistula lachrymalis. *Kolbè's pattern.*

Figs. 15, 16, 17, 18, 19, 20. Fine Eye Scissors, of different shapes, both straight and probe pointed, and adapted to the operations of pterygium, strabismus, slitting up the puncta lachrymalia, etc. *Kolbè's pattern.*

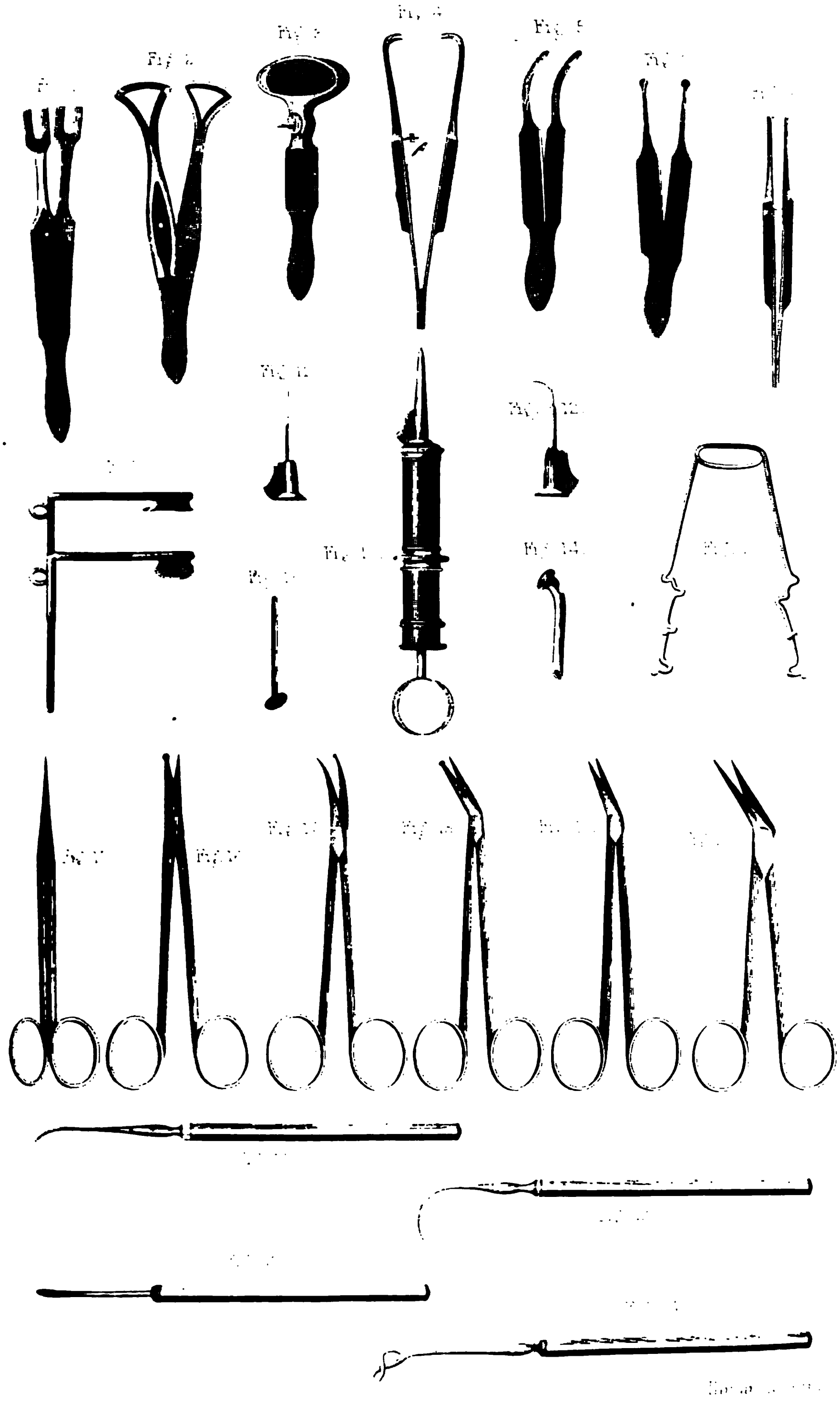
Fig. 21. A modification of Anel's Probe, for dilating the puncta in cases of epiphora. *Kolbè's pattern.*

Fig. 22. One form of the knife sometimes used to incise the conjunctiva in pterygium and strabismus. *Kolbè's pattern.*

Fig. 23. Hook of Hays, of Philadelphia, for seizing the muscle in the operation for strabismus. The curve is adapted to the convexity of the ball. *Kolbè's pattern.*

Fig. 24. The Elevator of Comperat, for sustaining the upper lid in operations for cataract. *After Bernard and Huette.*

Plate 8



the inferior turbinated bone about five lines from its anterior extremity—Plate XI. Figs. 1, 2—about seven lines from the bony orifice of the anterior nares, and about eight lines from the posterior inferior corner of the orifice of the nostril in the recent subject.

SECTION II.

DISORDERS OF THE APPENDAGES OF THE EYE.

§ 1.—Blows upon the Eye.

Blows upon the orbit of the eye produce generally more or less ecchymosis and discoloration of the tissues all round it, in consequence of the rupture of small vessels beneath the skin, the violence of the blow being pretty well indicated by the extent of the discoloration. The ecchymosis thus created is the "black eye" of popular language.

Treatment.—Contusions of this part are to be treated: 1. By such means as are calculated to check the effusion of blood into the subcutaneous areolar tissue. 2. By such as will lead to the absorption of that already effused. In order to attain the first object, nothing is better than cold and moderate pressure, articles of a stimulating character, such as the tincture of arnica, or other stimulating tincture being resorted to after a few days, in order to promote the absorption of the effused blood. But when these articles are employed, the evaporation of the alcohol, and the friction connected with their application, is doubtless an aid to absorption. The practice of painting the injured part flesh color, with water-colors, which is sometimes resorted to, to conceal the lividity, retards absorption, and, while it improves the appearance of the patient for a time, postpones the period of his cure.

§ 2.—Foreign Bodies in the Eye.

Foreign bodies of various kinds may lodge between the lids and the ball, or be driven into the eye itself, and in either case should be removed as soon as possible, in order to keep down inflammatory action.

Treatment.—The treatment depends upon the character of the foreign body, and the position which it has assumed. Thus, if caustic substances, such as lime, have been introduced between the eyeball and the lids, bland injections, as those of olive oil, mucilage, etc., should be immediately employed, with an eye-syringe, to counteract their corrosive effect, while others, as a locomotive cinder, or a piece of metal, should be directly acted on.

When the foreign body has passed back into the folds of the conjunctiva, and cannot be readily seen by opening the lids, the latter should be everted, as may be readily accomplished by pressing a probe or the end of a pencil upon the lid, while, with the other hand, traction is made upon the tarsal cartilage. The eversion being accomplished, the eye can be fully examined for the foreign body, the latter being generally readily discoverable, when it may be wiped out with the end of a handkerchief, or with a camel's-hair pencil. If numerous particles, as sand, etc., are attached to the surface of the lid, washing of the part with a syringe, and the subsequent application of mucilage, may be demanded. It sometimes happens that, owing to the force of its propulsion, a foreign body is driven into the structure of the eye, as into the conjunctiva, or through the conjunctiva into the sclerotic coat; or it may be imbedded in the structure of the cornea itself. Turners who work in metals are exceedingly liable to these accidents, small pieces of steel or other metal being thrown off by the revolutions of the lathe, and, striking upon the eye, penetrating it more or less deeply. In such a case, if the fragment has been driven quite through the coats into the ball of the eye, it is generally useless to attempt to remove it, as an abscess will form, and it will be thrown off when that opens, a process which involves the destruction of the eye, and the consequent loss of sight.

If the fragment, however, is simply imbedded in the sclerotic coat, or in the laminæ of the cornea, it may generally be removed by being drawn out with the point of a curved cataract needle—any little particle which is not removed in this manner being left to be thrown off by the ordinary processes of suppuration and ulceration.

If the foreign body is driven into the substance of the cornea, and cannot be extracted except by incising the corneal layers, it is best to wait until the fragment is loosened by the ulcerative process, particular attention being paid to the treatment of the ulcer, lest it result in the production of corneal opacity. The inflammation arising from these injuries should be combated by cold mucilaginous applications to the ball, as directed for conjunctivitis.

§ 3.—Wounds of the Eyelids.

Injuries of various kinds, as well as surgical operations, sometimes lead to the production of **Wounds of the Eyelids**, the treatment of which requires the use of sutures, and the observance of the general principles described in connection with wounds. The sutures in these wounds should generally be of fine lead thread, and removed about forty-eight hours after their introduction. On account of the loose nature of the connective tissue of the part, these wounds are liable to cause ecchymosis from the infiltration of the blood beneath the skin, a result which should be explained to the patient at the commencement of the treatment.

§ 4.—Tumors of the Eyelids.

Several of the tumors seen in other portions of the body are sometimes found developed in the eyelids. Most frequently they are a variety of the encysted tumor, which is seated in the areolar tissue, and readily removed either by incision of the cyst and the introduction of a sharp-pointed pencil of nitrate of silver, so as to create a slough of the sac; or by incising the integuments and sac, and drawing the latter out with fine forceps; or they may be dissected out, if care is taken to avoid cutting an opening entirely through the lids, as this is apt to prove difficult to heal, from the constant escape of tears through the wound. An important rule in removing these tumors by the knife is to make the incision parallel to the course of the fibres of the orbicularis muscle, either through the skin from without inward, or from the inside of the conjunctiva to the skin, according to the depth of the tumor. Usually, the tumor is removed from that side on which it seems to be most superficial, though the incision through the conjunctiva is least apt to produce a scar.

Desmarres, of Paris, employs a pair of forceps with broad ends, with a fenestrum in one of the blades, Plate VIII. Fig. 3, well calculated to support the lid, and at the same time circumscribe the tumor; and when the surgeon cannot obtain proper assistants, these forceps will prove most valuable. Generally, however, this operation is too simple to require anything more than to close the lid if the external incision is practiced, or its eversion if the tumor is to be excised through the conjunctiva. Then the tumor, being seized with fine and small forceps, or a tenaculum, may be readily dissected out. The operation of Desmarres, as well as that by eversion of the lid and incision of the conjunctiva, is shown in Plate IX. Figs. 1, 2.

Vascular tumors of the lids are occasionally noticed, but unless of unusual size may be treated like the encysted class, by the means just detailed. In large aneurisms by anastomosis, or those of such size as to promise free hemorrhage, the production of inflammation in the tumor by the introduction of a seton through it, as practiced by Lawrence, will generally answer a better purpose.

§ 5.—Hordeolum.

The **Hordeolum** or **Stye** is a little inflammatory swelling of the size of a grain of barley—whence the name—which is often quite painful, and generally due to inflammation either in the areolar tissue of the lids, or in one or more of the Meibomian glands, the inflammation causing the obstruction of the duct and the accumulation of its secretion, from the distention of which an abscess follows; or there may be simply the creation of a phlegmon of the lid. This affection may be confounded with a condition which is, in fact, a true abscess, and the result of inflammation of the areolar tissue between the fibres of the orbicularis palpebrarum and the skin, which runs the course of abscess elsewhere, and is far from being as painful as the true hordeolum.

Treatment.—In either case the treatment is precisely that which is adapted to any ordinary abscess, warmth and moisture being applied either by means of poultices or the warm water-dressing, or something more stimulating, as the alum curd. As soon as the formation of pus is observed, it should be evacuated by means of a cataract needle, or some similar instrument.

The popular plan of treating styes, by extracting one or two of the cilia, is only successful when the bulbs of these hairs are so situated that their withdrawal ruptures the abscess and evacuates its contents.

The chronic induration and thickening of the edges of the lids which is left after a stye, or after a succession of styes, should be treated by means calculated to produce absorption of the fibrin, to which the induration is due; such means are to be found in frictions with mild mercurial ointment, or with red precipitate, or iodine ointment, etc., or in painting the edge of the lid with a camel's-hair pencil moistened with a solution of nitrate of silver, grs. v to the ounce of distilled water.

§ 6.—Ophthalmia Tarsi.

Ophthalmia Tarsi or **Psorophthalmia** is a complaint of an inflammatory character that involves the Meibomian glands, the secretions of which are in consequence disordered so that the eyelids are glued together during sleep. This affection is common among the strumous children of asylums and hospitals, with whom it assumes a chronic character, and is exceedingly obstinate, resulting in destruction of the bulbs of the eyelashes, loss of the cilia, and a thickening of the conjunctiva of the lid, the latter being often more or less everted, so as to present the peculiar raw appearance of the edges of the lid which has been denominated "blear eye."

Treatment.—In its acute form this affection is to be treated by the antiphlogistic measures adapted to inflammation elsewhere; but when it becomes chronic, greater advantage will be obtained from improving the patient's general health by the use of tonics, chalybeates, etc., as well as by stimulating local applications, than from the use of depletory measures. In the case of scrofulous children, much benefit will also be derived from the continued administration of cod-liver oil, and from such general means as are adapted to the treatment of the tuberculous cachexia.

The local treatment is to be conducted upon those general principles which regulate the treatment of vitiated secretion and ulceration in other structures. The use of astringent ointments will often prove highly advantageous, such as that of the precipitated carbonate of zinc, which may be smeared upon the edges of the lids. Ointments of an alterative character, calculated to act upon the diseased Meibomian glands, are also exceedingly useful, and of these the best is probably the citrine ointment—Unguentum Hydrargyri Nitratis of the Pharmacopœia—which may be applied to the edges of the closed lids either pure or diluted with varied proportions of simple cerate, according to the acuteness of the disorder. It should be applied, by means of a camel's-hair pencil, the last thing before retiring at night; the patient immediately closing his eyes and not opening them again, if possible, till he falls asleep. Upon rising in the morning the eyes should be washed in *warm* water, not in cold, as the latter, by the reaction which follows its use, gives rise to increased vascular action.

Sometimes ophthalmia tarsi results in the production of such changes of structure as require local applications to modify more completely the action of the part, lest destruction of the mucous membrane, eversion of the lid, and other unpleasant consequences result. In this case, nothing better can be recommended than light cauterization of the edges of the lids with the nitrate of silver, in substance, or in a solution ten grains to the ounce of water.

§ 7.—Trichiasis.

Trichiasis—*τριχος*, a hair—is the name given to a complaint which consists in the in-growing or misdirection of the eyelashes. As normally placed, the eyelashes of the upper lid are convex downward, and those of the lower lid convex upward, so that when they meet, dust is effectually excluded from the eyes, and yet there is no danger of the hairs coming in contact with the delicate conjunctival surface. Sometimes, however, as a result of disease, whether such as elongates the lid, or only affects the bulbs of the ciliæ, the eyelashes are brought against the ball, producing much irritation, and resulting finally, if unrelieved, in inflammation of a troublesome character.

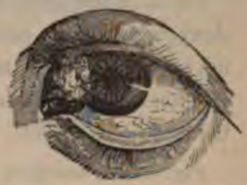
Treatment.—The treatment may be palliative or radical. The palliative treatment consists in the extraction of the ciliæ by means of ciliæ forceps, and, if the extraction is performed carefully, the relief will be complete for the time. Generally, however, a new growth of ciliæ reproduces the disease, and it may then become necessary to resort to some radical mode of cure. If the disease is produced by inversion of the lids or entropion, it will be relieved by the operation appropriate to that condition; but if due to a disorder of the bulbs of the ciliæ, the only method upon which the slightest reliance can be placed is cauterization of a sufficiently active character to destroy the bulbs completely.

Distichiasis—*δις*, double, and *στιχος*, a row—designates the existence of a double row of eyelashes, one of which grows inward. The treatment of the second, or inner row, is similar to that just mentioned as demanded by Trichiasis, the employment of a magnifying glass being often useful in detecting the positions of some of the lashes.

§ 8.—Encanthus.

This complaint—named from its position, *εν*, in, *ϰανϑος*, the angle of the eye—consists in an enlargement or degeneration of the caruncula lachrymalis. When requisite, the tumor may be removed by seizing it with a tenaculum or forceps, and excising it with fine-curved scissors, or with a small scalpel, taking care not to remove the conjunctiva, so that the cicatrix shall hold the ball to the inner canthus.

Fig. 382.



A front view of an Encanthus of some size.

§ 9.—Epicanthus.

Epicanthus—*επι*, upon, *ϰανϑος*, the angle of the eye—consists in the formation of a fold in the skin at the root of the nose, in consequence of which the internal canthus is, in a measure, concealed. It is a rare complaint, and occasionally requires an operation in order to enable the patient fully to expand the lids. The operation of Von Ammon, of Dresden, consists in pinching up a longitudinal fold of the skin, excising it at the root of the nose of a sufficient width to efface the epicanthus, either with the knife or scissors, and then uniting the elliptical wound thus made by a hare-lip suture, Plate IX. Fig. 11.

§ 10.—Ankyloblepharon.

Ankyloblepharon—*αγϰυλη*, contraction, *βλεφαρον*, the eyelid—is a disorder so named from the preternatural adhesion to each other of the free margins of the lids. It is generally the result of the inflammation produced by burns, caustics, etc. The union of the edges of the lids may be either partial or total, and is usually found at the external canthus, where, if partial, as is often the case, a director may be passed between the lids and the eyeball, and the adhesions divided either by a probe-pointed bistoury or by probe-pointed scissors. If they are more extensive, and the eye is entirely closed, the lid may be raised in a vertical fold, and a small opening made through it at the external canthus, in order to permit the introduction of the director; when the operator, after satisfying himself that the lids do not adhere to the ball—symblepharon—may pass a bistoury along the director, and divide the adhesions at the edges of the cartilages.

After the operation, care must be taken to prevent the reproduction of the complaint, by anointing the wounds thus made with some mild cerate, or by lightly cauterizing their edges with the nitrate of silver; or by separation of the lids by adhesive plaster, by collyria, or by liniments; or by uniting the conjunctiva to the skin at the external canthus, by a fine silver suture. But great difficulty may be expected, and a partial failure is not uncommon.

§ 11.—Symblepharon.

Symblepharon—*συν*, with, and *βλεφαρον*, an eyelid—is an adhesion of the conjunctival surface of the lids to the ball of the eye, in which the cornea participates, and is generally the consequence of violent inflammation resulting from the introduction into the eye of caustic or other irritating substances, as

PLATE IX.

OPERATIONS UPON THE EYELIDS.

Fig. 1. Extirpation of an encysted tumor from the upper lid by an incision on its external face. 1. The incision over the tumor. 2. Desmarre's ring forceps. *After Bernard and Huette.*

Fig. 2. Extirpation of an encysted tumor in the lower lid, by an incision through its mucous membrane. 1. Desmarre's bifurcated forceps holding the lid, as everted over 2, the handle of a cataract needle. 3. Fine forceps raising the tumor. 4. Its dissection by the straight bistoury in the line of the fibres of the orbicularis muscle. *After Bernard and Huette.*

Fig. 3. The ordinary operation for ptosis. 1. A pair of forceps pinching up the necessary amount of the skin of the upper lid. 2. The horizontal fold thus raised. 3. The scissors excising the raised portion, close to the grasp of the forceps. *After Bernard and Huette.*

Fig. 4. The shape of the wound, 1, 2, 3, left after the removal of the skin on the eyebrow—in Hunt's operation for ptosis. *After Bernard and Huette.*

Fig. 5. The wound united by fine hare-lip sutures, and its effects in elevating the lid. *After Bernard and Huette.*

Fig. 6. Weller's operation for ectropion of the lower lid by excision of the middle of the tarsus cartilage. *After Bourgery and Jacob.*

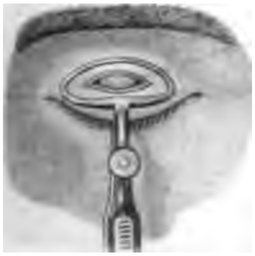
Fig. 7. Von Ammon's operation for symblepharon. The portion of the lid which is adherent to the ball has been included in the base of a V incision, 1 3, 2 3, which, starting at the tarsus cartilage, has been carried through the lid. *After Bernard and Huette.*

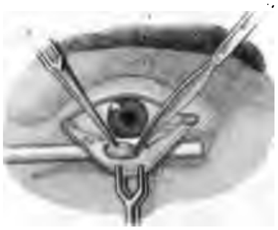
Fig. 8. The same operation completed; the edges of the incision through the skin and muscle of the eyelid have been united by three hare-lip sutures, so as to leave a triangular fold of the conjunctiva attached on the edge of the tarsus cartilage, but otherwise free from the lid, thus favoring its motions on the ball. *After Bernard and Huette.*

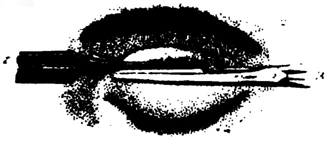
Fig. 9. Dieffenbach's operation for the cure of a triangular wound of the lower lid, left in removing a tumor. 1, 2, 3. The wound. 4, 5. The flap which is to be inclined so as to close it. *After Bernard and Huette.*

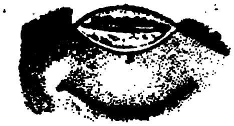
Fig. 10. Jones's operation for blepharoplasty, or the formation of a new lid by sliding up a flap from the cheek. The operation is represented as completed. 1, 2, 3. The triangular flap raised from the cheek, and fitted into the lid by various points of the suture. 3, 4. Closure of the wound left by the removal of the flap from the cheek. *After Bernard and Huette.*

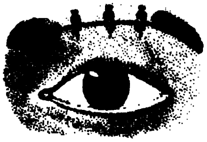
Fig. 11. Von Ammon's operation for epicanthus. 1, 2, 3. The elliptical wound resulting from the removal of a fold of the skin at the root of the nose. *After Bernard and Huette.*

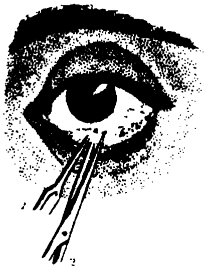


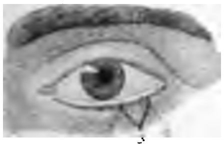


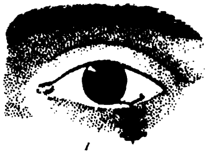


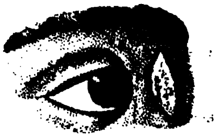


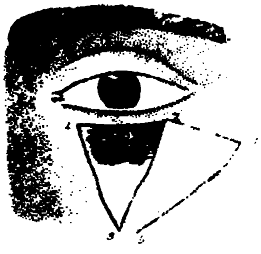


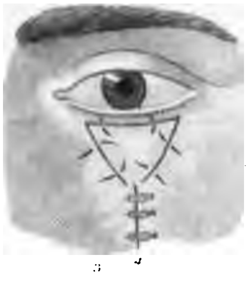












a drop of oil of vitriol, or a particle of lime, or red-hot iron. Division of the adherent points by probe-pointed pterygium scissors—Plate VIII. Figs. 16, 17, 18—or, if slight, their laceration by a pin or cutting instrument passed between the lids and the ball, as practiced by Amussat, will generally overcome the complaint. Or a double thread may be passed through the adhesion, and one end tied close to the sclerotica with great firmness, and the other toward the lid less tightly, as proposed by Petrequin; but care must be exercised to guard against the reproduction of the band.

As it has been found very difficult to prevent the renewal of the adhesions, the ingenious operation of Von Ammon may be resorted to, Plate IX. Fig. 7. Circumscribe, by two incisions—1, 2, and 2, 3—through the whole thickness of the lid, that portion which is adherent to the eyeball, and the triangular flap thus separated from the remainder of the lids will follow the eye in all its motions. Then, by two or three small pins and the twisted suture, unite the edges of the wound, so as to leave the triangular flap—Plate IX. Fig. 8—inside, and adherent to the eyeball, until the wound has fully cicatrized, when the flap may be dissected from the ball without any risk of the production of new adhesions.*

§ 12.—Ptosis.

Ptosis — πτωσις, a falling — signifies either a total or partial inability to raise the upper lid, and may result either from a congenital excess of integument, or from want of power in the levator palpebræ muscle, or from spasm of the orbicularis palpebrarum, in consequence of which the lid droops upon the eyeball. When dependent on paralysis of the levator palpebræ muscle, or the nerve of the third pair supplying it, Garratt, of Boston,† recommends the application of Faradian electrical currents, a remedy well worthy of trial; one of the electrodes being applied to the external canthus, and the other to the middle of the orbital ridge, the current being at first lightly applied. When this, or such other remedial measures as are adapted to the disorder causing the falling of the lid, as blisters, strychnia, etc., have failed in affording relief, an operation may become necessary, in order to accomplish the mechanical elevation of the lid and open the eye sufficiently for the purposes of vision.

Operation.—To accomplish this in the ordinary method, raise a transverse fold of the upper lid in a pair of forceps, and either with the scalpel or scissors—Plate IX. Fig. 3—cut off the portion thus raised, so as to leave an elliptical wound, which should not, however, include the conjunctiva, uniting the edges of the incision by two or three fine stitches of the interrupted suture. A very important point in the result of the operation is the correct calculation of the amount of integument to be included in the fold seized by the forceps; if too much is raised, the patient may subsequently suffer from ectropion, or be unable to close the lid; and if too little, it may become necessary to repeat the operation.

In the operation of Hunt, of Manchester—Plate IX. Fig. 4—the eyebrow is first shaved clean above the point at which a semi-elliptical piece is to be excised, the extent of the flap being calculated according to the amount of the relaxed portion of the lid. This flap may be circumscribed by an elliptical incision of the lid and eyebrow, 1, 2, 3, the lower half being made first, and the upper dissected until it exposes the lower fibres of the musculus frontalis. Then, on uniting the wound by three stitches of the twisted suture, the cicatrix will form in the eyebrow, and be subsequently concealed by the hair, Plate IX. Fig. 5. The adhesion thus formed between the lid and the frontal muscle will enable the patient to elevate the lid by the contraction of the muscular fibres just referred to.

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* Bernard and Huette, p. 115.

† Electro-Physiology, p. 643.

§ 13.—Lagophthalmus.

Lagophthalmus—*Λαγος*, a hare, and *οφθαλμος*, an eye—or *hare* eye is the name given to a complaint due to a loss of power in the orbicularis palpebrarum muscle, in consequence of paralysis of the portio dura, which then leaves the eyeball uncovered and exposed to particles of dust, etc., thus inducing inflammation, as the eye remains uncovered both day and night.

Treatment.—As this condition is due to a local paralysis, created often by injury or local disorder, as paralysis from cold, etc., the application of a small blister over the eye or temple, and below the ear, and dressing the raw surface with strychnia applied as a powder, diluted with powdered gum-arabic, or in the form of ointment, may prove useful. The galvanic current passed through the muscle is also highly useful.

§ 14.—Blepharoplasty.

The formation of a new eyelid at the expense of some portion of the adjacent integuments is termed **Blepharoplasty**—*βλεφαρον*, the eyelid, and *πλαστικος*, forming or formative—and may be required for the relief of cicatrices from burns, or for the loss of the substance of the lid resulting from the removal of large tumors, or in order to remedy an error consequent on an extreme miscalculation of the portion of integument removed in the operation for Ptosis just described, or for the cure of Ectropion. Under any of these circumstances, the ordinary rules for plastic operations* must be borne in mind, especially the necessity of making an apparently excessive flap at first, in order to counteract the contraction which is so apt to follow all plastic operations, and in a very marked degree those performed to remedy the defects of cicatrices. As the different methods of operating in plastic surgery will be described subsequently, the account at present may be limited to the operations usually resorted to in the formation of the eyelids.

Operation of Wharton Jones, of England, or the formation of a flap by stretching the integuments, Plate IX. Fig. 10. After having pared the edges of that portion of the lid which is to be renewed, so as to obtain a fresh surface, two incisions in a V—1, 4, and 2, 4—are to be made near the wound, as upon the forehead, if in case of the upper lid, or upon the malar or superior maxillary bone, if for the lower; the top of the V-flap, thus formed, being intended for adhesion to the lower portion of the lid. After thus circumscribing the flap, it should then be dissected from the base of the triangle 1, 2, to near the summit 4, and, when freed from the subjacent structure, excepting at its summit, it should be gently drawn upon until it fills in the desired space, when it may be retained in its new position by several stitches of the interrupted suture. The gap left in the portion from which it has been drawn may then be closed by approximating the edges and uniting them with the hare-lip suture. The figure represents the flap 1, 2, 3 in its new position, and the union of the sides of the gap 3, 4 by the hare-lip suture, which thus converts a wound of some size into a mere line.

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* See Operations on the Nose.

The reader will readily see, by reference to the figure, that the wound at 3 was of the width of 1, 2, previous to its elevation.

In the operation performed by **Dieffenbach,** or the formation of a flap by sliding the adjoining skin, a sufficiently triangular flap, 3, 4, 5, Plate IX. Fig. 9, was raised so as to fill the gap or wound 1, 2, 3, allowing, as before stated, for subsequent contraction, which may usually be calculated at about one-third of the whole flap. This being dissected free from its attachments, with the exception of its pedicle 3, 5, was afterward slipped into the wound 1, 2, 3. The other gap, 3, 4, 5, from which the flap had been formed, was then left to cicatrize as a simple ulcer.

In the German operations of **Græfe** and **Fricke,** which are modifications of the ancient twisting of the flap as practiced in India, the cicatrix, or diseased portion, was removed so as to leave a fresh surface, 1, 2, 3, 4, Plate X. Fig. 1. Then a properly shaped flap, 3, 5, 6, of good dimensions, and at least one-third larger than the wound, was dissected from the adjoining sound skin, and twisted at 3, so as to adapt itself to its position. Being subsequently attached by the interrupted suture to the surrounding portion of the lid, the space caused by its removal was closed by the hare-lip suture, as in 2, 3, Plate X. Fig. 2.

§ 15.—Ectropium.

Eversion of the Eyelids, or **Ectropium**—*εκτρεπω*, to turn out—may result either from adhesion of the external surface of the lids to the surrounding integuments; from a diseased condition of the conjunctiva, or of the tarsus cartilage; or from irregular action or want of power in the orbicularis muscle.

Fig. 383.

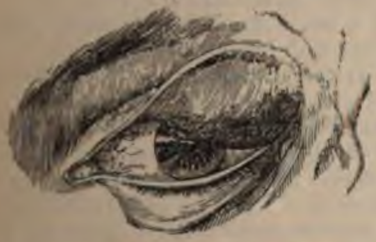


Fig. 383.—Ectropium of the Upper Lid, showing the amount of palpebral conjunctiva exposed to the atmosphere.

Fig. 384.

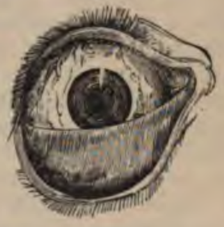


Fig. 384.—Ectropium of the Lower Lid, the result of a cicatrix in the cheek.

In the milder cases of the disease, or those resulting from a hypertrophied condition of the conjunctiva, much may be accomplished by free leeching, astringent collyria, or cauterization of the conjunctiva in lines parallel to the fibres of the orbicularis, which, though forming a linear cicatrix, is yet buried in the surrounding folds, and causes little irritation; or by the excision of a fold in the same direction, by raising it with the simple forceps, and removing it with fine scissors. But in more obstinate cases, blepharoplasty, or the formation of a new lid, must be resorted to, in order to enable the tarsus cartilage to apply itself properly to the ball. In these, as in all plastic operations, I repeat that it is important to avoid making the flap too small, as its contraction will continue for weeks subsequently; double the amount apparently required being often barely sufficient, after its adhesion in its new position.

PLATE X.

OPERATIONS FOR THE RELIEF OF AFFECTIONS OF THE EYELIDS.

Fig. 1. Blepharoplastic operation of Græfe on the Upper Lid, effected by twisting the flap. 1, 2, 3, 4. The elliptical wound left in the upper lid by the removal of a tumor, etc. 3, 5, 6. The incision circumscribing a flap upon the skin at the external angle of the orbit, and destined to fill up the wound. *After Bernard and Huette.*

Fig. 2. A view of the operation as completed; the flap is retained in the lid by the sutures 1, 1, 1, while the space 2, 3, left by the removal of the flap, is closed by a fine hare-lip suture. *After Bernard and Huette.*

Fig. 3. Operation of Sir William Adams for Ectropium. 1. The first incision made through the lid by cutting from within to the tarsus; the edge of the tarsus beyond this incision is then held by 2, the forceps, and a triangular piece of the lid removed by 3, the scissors. *After Bernard and Huette.*

Fig. 4. Dieffenbach's operation for Ectropium. 1, 2. Longitudinal incision through the skin and muscle of the lower lid; the mucous membrane is then seized with 3, the forceps, and a fold excised with 4, the scissors; a suture unites all together and the cicatrization of the conjunctiva in the wound inverts the edge of the lid. *After Bernard and Huette.*

Fig. 5. Desmarres' operation for Ectropium. 1, 2. The first incision at the external canthus. 2, 3. The second incision, which, commencing at 3, terminates at 2. 1, 4, 3, 4. Two incisions, which, starting from the terminations of the first, unite at 4 on a line with the reflection of the conjunctiva from the lid to the ball. *After Bernard and Huette.*

Fig. 6. The same operation, as completed. " " " "

Fig. 7. Operation of Janson for Entropium. 1. Adams's forceps raising a fold of the skin of the lid near the internal canthus. 2. Scissors curved on the flat, excising the portion thus raised. 3, 4. The same kind of incision completed near the external canthus. *After Bernard and Huette.*

Fig. 8. A view of Horner's operation for Ectropium in the Right Eye, resulting from a burn. 1, 2. An incision along the edge of the lower lid to free it from the cheek. 3, 4. A second incision, an inch long, from the middle of the first toward the angle of the jaw. 4, 5. A third incision from the termination of this toward the point of the nose. 3, 6. Two angular flaps formed by these incisions. *After Horner.*

Fig. 9. The termination of this operation. 1, 2. Lower edge of lid. 6. The lower angular flap raised to the edge of the lid, and fastened at its angle by a pin. 3. The upper angular flap depressed to fill in the gap. *After Horner.*

Fig. 10. Brainard's modification of Fricke's operation for Ectropium in the Left Eye resulting from a burn, the flap being taken from behind the external angle of the eye, and rotated upon its base so as to fill up the space left by detaching the lid from the cheek. *After Brainard.*

Plate 10

Fig. 1.

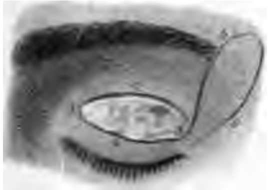


Fig. 2

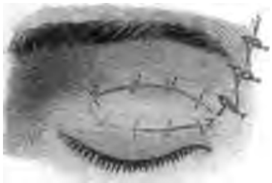
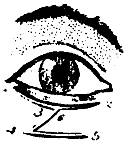


Fig. 8



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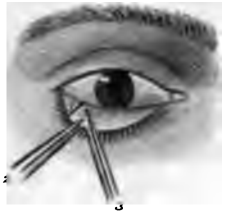


Fig. 4

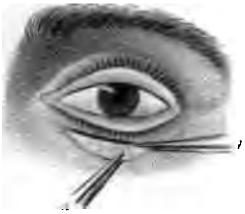


Fig. 5

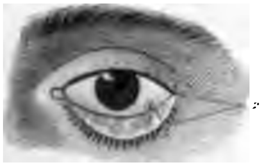


Fig. 6

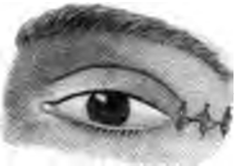


Fig. 9

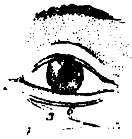


Fig. 7

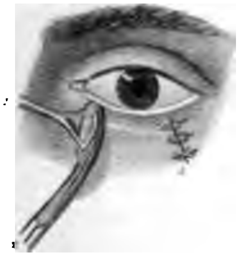
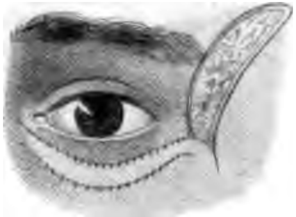


Fig. 10.



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through the conjunctiva by the side of the tarsus, and disengage the flap at each extremity, the only caution being to leave the punctum lachrymalis uninjured. The fungus subsequently formed in the cicatrix is either to be cauterized or excised.

When the inversion of the lid is due to a contraction or cicatrix in the conjunctiva or in the cartilage, and is the result of deep ulceration, the operations of Sir P. Crampton, Guthrie, or Tyrrell may be employed.

Crampton's Operation.—In this operation, the tarsus cartilage is to be divided perpendicularly at each canthus by two incisions, each about three lines long, care being taken to avoid the punctum, after which a transverse incision of the conjunctiva should be made so as to unite the two vertical cuts. Two or three ligatures being then passed through the skin at its tarsal margin, the divided portion of the eyelid is to be carried up to the eyebrow, and the ligatures fastened to the forehead by strips of adhesive plaster.

Guthrie's Operation.—This is a modification of Crampton's, and is performed as follows: Two perpendicular incisions, a quarter of an inch long, having freed the tarsus cartilage from its attachments at each end, and any vicious curvature of the cartilage being overcome by dividing it at the place where it is bent, cut a fold of skin of the length of the lid between the vertical cuts, and remove it as close as possible to its margin. The edges of the wound being then united by fine sutures, secure the lid to the forehead as in the preceding operation, and apply caustic frequently to the perpendicular incisions, so as to cause them to heal by granulation.

In cases due to contraction of the orbicularis palpebrarum muscle, as suggested by Key, in 1825, and since urged by Walton, the following method of operating may suffice:—

Walton's Operation.—An assistant standing behind the patient, and making the lid tense by drawing it outward and forward while raising the brow, make two incisions through the skin and muscle, one parallel with, and as close as possible to the roots of the ciliæ, and the other so that it will form an elliptical flap of about three lines at its greatest width and terminate at each end of the tarsal cut, thus making an oval wound. The flap, thus isolated, being then forcibly drawn forward and slowly dissected by vertical strokes of the knife, close the wound by three or four fine sutures, and apply the cold water-dressing. The hemorrhage yields to the pressure of the finger or cold water applied before closing the wound. In fifty cases operated on in this manner, Walton has never seen a bad symptom.

Estimate of the Value of these Operations.—In estimating the value of the operations just detailed as practiced on the eyelids, so much must depend upon the peculiarities of each case, that it is, perhaps, best to leave a decision of their value to the judgment of each operator. In deformities resulting in Ectropium, and consequent on burns or ulcers, the tendency to contraction is so great that, in all the plastic operations, too much integument can scarcely be obtained. In all such instances, blepharoplasty presents the best chances of success; but even then the operator should be very guarded in his prognosis. In the case of a young lady in whom the upper lid had contracted adhesions to the edge of the orbit, in consequence of a burn, leaving the eyeball exposed to dust and other irritation, I formed a flap from the forehead, making it more than three times as large as the space to be filled in the lid, and, fastening it in position, obtained union by the first intention. Yet six months subsequently, the cicatrization of the wound from which the flap was taken, and the contraction of the latter, had again elevated the lid nearly to the edge of the orbit.

In entropium, I should, as a general rule, prefer the operation of Key, as modified by Walton, to most of the others. The operation of Dorsey is, I think, preferable to that of Saunders, not only from its simplicity, but from its completeness. In cases due to the contraction of the cartilages, the operation of Guthrie is generally preferable to the operation of Crampton.

SECTION III.

DISORDERS OF AND OPERATIONS ON THE LACHRYMAL APPARATUS.

The principal disorders to which the lachrymal apparatus is exposed are scirrhus, or such other degeneration of the lachrymal gland as may necessitate its removal; obstruction of the puncta lachrymalia; thickening and stricture of the ductus ad nasum, or suppuration and ulceration of the lachrymal sac. Sometimes there is a marked diminution in the secretion of the gland, and a corresponding dryness of the eye that is termed **Xeropthalmia**, which demands mucilaginous washes, and such local and general treatment as is required for the relief of diminished secretions in other glands. When the puncta are contracted or obliterated, the tears flow over the cheek, or the eye is watery, constituting the condition designated as **Epiphora**. In contraction of the puncta lachrymalia, or of the canalicula lachrymalia, that creates epiphora, it occasionally becomes necessary, after employing antiphlogistic measures and mild collyria, to dilate the puncta and canals by a probe, or to slit them up, or to wash out the sac and ductus ad nasum, and diminish inflammation.

1. **Dilatation of the Puncta.**—To one familiar with the anatomical relations of the part, catheterism of these ducts is a simple affair, and may be accomplished by introducing Anel's probe, or, what is better, the blunted point of a fine cambric needle fastened in a handle, or the instrument represented in Plate VIII. Fig. 21, into the punctum, and repeating the operation from time to time, as it may be required.

2. **Incision.** — Bowman, of London, advises enlarging the lachrymal canals by dilatation, with probes of different sizes, after enlarging the punctum by inserting the point of a pair of fine scissors to the distance of one line, and dividing the ring at the orifice, by one cut.

3. **To Dilate the Canals and Ductus ad Nasum.**—When the punctum is pervious, draw the eyelid toward the temple, in order to straighten the canalicula and prevent a fold of the mucous lining from being pushed in front of the point of the instrument. Then introducing a fine probe—or one fastened into a light handle to facilitate its manipulation—Plate VIII. Fig. 21, into either punctum, by passing it perpendicularly into the orifice, and carrying the handle toward the temple, or nearly parallel with the lids, pass it gently toward the inner canthus of the eye. On reaching the sac, elevate the instrument from the horizontal nearly to a perpendicular direction, and carry the handle obliquely forward, when the point will pass readily into the nose, Plate XI. Fig. 2. The figure shows the probe when it has reached the sac and is about to pass into the duct, and the dotted line indicates its course downward. The introduction of a probe from the nostril into the duct, as suggested by Laforest, is also shown in the drawing; but the operation has little to recommend it, being opposed to the anatomical relations of the parts, and the same end is better accomplished by operating from above.

4. **To Wash out the Canals and Sac.**—Introduce one of the fine points of Anel's syringe into the lower punctum, holding the instrument with the forefinger upon the piston, as shown in Plate XI. Fig. 3. Then elongating the lid, throw in the fluid by the motion of the forefinger, taking care not to press the point of the syringe into the membrane lining the canals, nor to

push a fold of it in advance of the instrument. If the liquid does not pass out of the syringe as freely as the orifice should permit, withdraw the point a little, and again passing it forward it will be easy to avoid any duplicature of the membrane. While injecting either punctum, the other should be closed to prevent regurgitation. If the liquid passes freely through the duct, the fact will soon be rendered apparent by its escape either from the nose or throat of the patient, according as the head is held forward or backward. The liquid injected may consist either of simple water or of mild alterative collyria. If the operator can only use his right hand, he must stand either in front of or behind his patient, according to the eye to be operated on—that is, in front for the left eye, and behind the patient when operating on the right; but if he is ambidexter, his position will be immaterial.

5. **Dacryocistitis**—*δακρυον*, a tear, and *κυστις*, a bladder—or inflammation of the lachrymal sac, is a complaint that usually runs the course of mucous inflammation elsewhere; that is, either disappears by resolution, or ends in suppuration and stricture of the canal. When it results in suppuration, or when an abscess of this structure ulcerates, and opens upon the integuments, it constitutes the condition known as **Fistula Lachrymalis**, and requires the dilatation of the ductus ad nasum to restore the patulous condition of both the duct and saccus lachrymalis if adherent to adjacent parts.

The introduction of a bougie, style, or canula requires the formation of an opening through the integuments into the sac, unless the discharge from the abscess has created a fistulous orifice by ulceration.

In many cases the ductus ad nasum, if strictured, can be dilated by a probe passed through the punctum lachrymalis and the sac into the nose. But in very chronic cases it may become necessary to induce absorption of the fibrin, or to establish suppuration, as is done in very bad strictures of the urethra, and in these cases a bougie may be worn in the duct for many weeks, though this is not now as frequently done as it was formerly.

The **ordinary operation** of introducing a style or bougie into the duct is performed as follows: Endeavor to render the ligamentum palpebrale prominent by drawing the lids outward, as it is the great point of reference, the sac lying somewhat in front and below it. When, on account of the swelling or inflammatory thickening of the integuments, the operator cannot feel this ligament, he must be guided in his puncture by the prominence formed by the distended sac, or by his knowledge of its proper position, and especially its relation to the edge of the orbit, or by a fine probe passed into the sac through the lower punctum, if possible. Then taking a narrow, straight, and sharp-pointed bistoury, and, standing in front of the patient for the left eye, and behind him if the disease is in the right one, puncture the integuments and anterior surface of the sac by pressing the point of the knife (with its back turned toward the nose) obliquely downward and backward. On entering the sac, bring the handle to a nearly upright position, and carry it forward slightly toward the nose, and downward, so as to make the point pass backward and obliquely outward and downward, Plate XI. Fig. 4. Retaining the bistoury in the duct, pass a probe along the knife as a director until it reaches the nostril, and, withdrawing the bistoury, pass the style, or bougie, or canula along the course of the probe, and, withdrawing the latter, fasten the instrument down by a piece of adhesive plaster, or simply trust to its retaining its position in consequence of the depth to which it has been introduced. Some surgeons, and especially the French, prefer passing the canula of Dupuytren along a groove made in the knife, in order to conduct it into the duct with greater certainty; but in the United States, the style of Ware, with the head blackened by a little varnish or sealing-wax, and employed in the manner just directed, is used whenever

PLATE XI.

OPERATIONS PERFORMED FOR THE OBSTRUCTION OF THE LACHRYMAL PASSAGES.

Fig. 1. A side view of the relative positions of the different portions of the Lachrymal Apparatus of the Left Eye. The upper and lower eyelids, with a small portion of the bones and integuments on the side of the nose, have been removed so as to expose the structure freely. 1. The lachrymal gland in its natural position at the edge of the orbit, near the external angular process of the os frontis. The conglomerate structure of the gland is well shown. 2. The superior punctum lachrymalis, with the course of its canalicula, to the saccus lachrymalis. 3. The inferior punctum lachrymalis in its course to the sac. The head, or enlargement of the ductus ad nasum, sometimes designated as the Saccus Lachrymalis, is seen between the lines of 2 and 3. 4. The ductus and nasum, exposed by removing its anterior parietes. Its course from the puncta down to the inferior turbinated bone, and the direction to be given to instruments introduced into it, can thus be readily understood. *After Bernard and Huette.*

Fig. 2. A three-quarter view of the Face. Anel's probe has been introduced into the upper punctum and carried into the lachrymal sac, whence it may be made to enter the nose. The dotted line shows the course that the instrument would take, and the probe in the nostril indicates the position of the instruments when passed into the duct from the nose, as in the plan of Laforest.
After Bernard and Huette.

Fig. 3. The position of the operator's fingers, when washing out the lower punctum with Anel's Syringe. The mode of holding the syringe so as to prevent undue pressure on the canal is also shown. *After Bourgery and Jacob.*

Fig. 4. Operation of puncturing the Lachrymal Sac of the Left Eye in cases of obstruction. The forefinger of an assistant is represented making traction on the lid so as to render the position of the palpebral ligament apparent, if the swelling and inflammation permit it. A straight, narrow bistoury has punctured the integuments and anterior face of the sac, and, while retained in its position, a probe has been passed along the blade of the knife into the duct and thence into the nose. *After Bernard and Huette.*

Fig. 5. Operation upon the Right Eye; the bistoury, after puncturing the sac, has been retained in its position until Ware's style could be introduced. This is now seldom resorted to. *Modified from Bernard and Huette.*

Fig. 6. Fistula Lachrymalis, and the introduction of a bougie into the duct through the fistulous orifice, as formerly practiced.
After Bernard and Huette.

Fig. 1

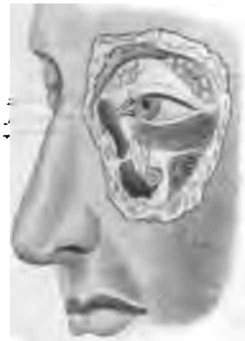
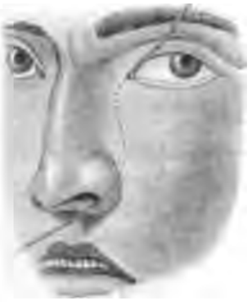


Fig. 2



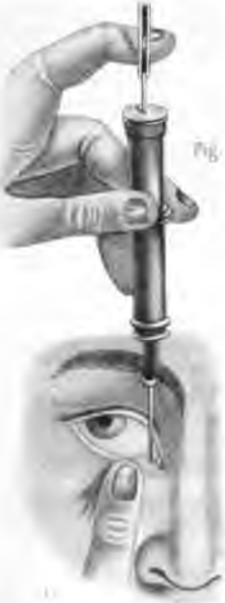


Fig. 3

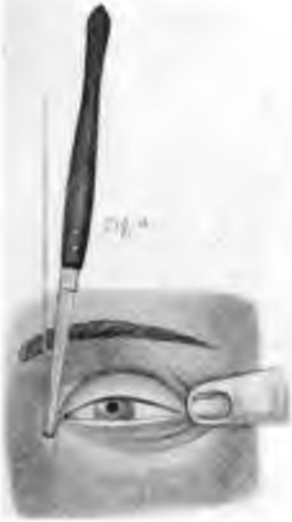


Fig. 4

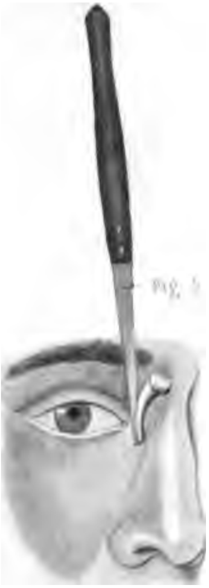


Fig. 5

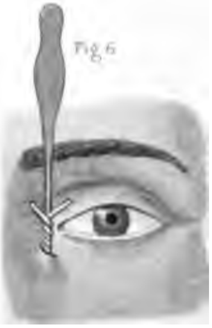


Fig. 6

it is deemed necessary. To guard against a change in the relations of the soft parts, consequent on the escape of the pus when the sac is opened, the employment of a probe passed into the duct before the bistoury is withdrawn, if the style cannot be passed in the first instance, will be found most serviceable; and I have more than once seen surgeons entirely baffled in the introduction of the style, in consequence of withdrawing the bistoury before the probe or style was fairly in the orifice made in the sac. From the collapse of the sac after its puncture, there is also, occasionally, risk of the style passing *outside* of the lining membrane, or between it and the bony duct, so as to separate the former entirely from the bone, thus leading to entire obliteration of the cavity, as well as to disease in the os unguis. Whenever, therefore, great difficulty is experienced in introducing the style, caution in reference to this accident becomes necessary. If the duct is obliterated, a perforation may be made through the os unguis from the sac; but if it is only closely strictured, the practice of employing caustic, as recommended by Haxhall, of Richmond, will be found serviceable. The plan proposed by Haxhall is the same as that recommended by Ducamp in stricture of the urethra, viz., first to take a mould of the stricture by a soft bougie, and then apply lunar caustic to the constricted part. The same idea was previously suggested by Nath. Smith, of Dartmouth College, in 1817, though he employed caustic potash instead of the lunar caustic. His mode of using it was as follows:—

Nathan Smith's Operation.—Render the tendon of the orbicularis (lig. palpebrale) conspicuous, cut into the sac, introduce a probe, and find the obstruction. Then substitute a bougie armed with a morsel of caustic potash, press the alkali upon the opposing membrane, and the obstruction will soon be overcome or the passage dilated. Catgut is not a good material for a bougie in these cases, as it is irritating and becomes decomposed, favoring the formation of fungous granulations around the orifice, owing to the separation of its fibres as twisted and the irritation they develop.

6. **Perforation of the Os Unguis.**—When the duct is so perfectly obliterated that its patulous character cannot be restored, then it may be necessary to make a perforation into the nostril by means of a punch—Plate XIII. Fig. 23—or a fine trocar, or the bone may be punctured and the fragments carefully picked out, in order to guard against the subsequent closure of the wound. To prevent extensive fracture or laceration of the neighboring parts, the puncture must be made with care. This operation is, however, rarely resorted to.

After-Treatment.—After the introduction of the style or bougie, they may be fastened in their position by a morsel of adhesive plaster, though, most frequently, the swelling of the integuments will be sufficient to retain them. After the lapse of six or eight days, the style should be removed by seizing its head with a pair of dissecting forceps, and withdrawn by a movement which is the reverse of that employed for its introduction. The point of a syringe being then placed in the canal, the part should be thoroughly washed, and the pervious character of the passage tested by the escape of the water either from the nostrils or into the throat of the patient. Then replacing the style, the same means should be resorted to from time to time, until all inflammation has subsided, after which common cleanliness is all that is requisite. The patient should, however, wear the style for at least six months, or until the permeable character of the ductus ad nasum seems well established. On finally removing it, the orifice will heal readily under the occasional application of the nitrate of silver.

Remarks.—In the early stages of inflammation in the sac or its duct, and in the lighter forms of stricture, the antiphlogistic treatment, and the dilatation of the ductus ad nasum by a probe passed through the punctum lachrymalis into the nose, will often suffice for the cure; but when the stricture is denser, and the disease is more advanced, puncture of the sac and the subsequent introduction of a bougie or style in the manner just detailed may be required. Puncturing the os unguis can only be demanded when the surgeon finds it impossible to introduce an instrument into the nose, and can only therefore be attempted as a last resort.

CHAPTER III.

DISORDERS OF THE EYEBALL.

An account of the disorders of the eyeball and of the anatomical relations of its component parts may be limited either to a brief enumeration of the general characters of each portion, or extended into a minute description of the structures concerned. From the importance of the diseases of this organ, the latter course has generally been pursued by surgeons who have devoted themselves especially to this branch of the profession. The general character of the present work, and the necessity of affording to other subjects an equal amount of space, must, however, preclude any attempt at a more detailed account of these than is essential to the comprehension of their treatment by the student.

SECTION I.

ANATOMY OF THE EYEBALL.

The eyeball is composed of six coats and three humors.

The coats are the conjunctiva, sclerotica, and cornea, which may be described as external; and the choroid, iris, and retina, which are within the former. The humors are the aqueous, crystalline, and vitreous.

The **Conjunctiva,** or mucous coat, after lining the lids, is reflected upon the ball, and covers both the sclerotica and cornea. To the sclerotica it is loosely attached by areolar tissue, in consequence of which it is liable to fluid infiltration, as well as to great vascular engorgement, either of which may raise it from the sclerotica. The course of its blood-vessels is tortuous. To the cornea it adheres very closely, furnishing it a thin layer, which is occasionally the starting-point of ulcerative inflammation. The **Sclerotica** is a dense fibrous coat which has, by some, been considered as an expansion of the dura mater of the brain. In connection with the operations performed upon the eyeball, it may be described as extending from the optic nerve as far forward as the circumference of the cornea, the two being closely adapted to each other by a beveled surface. The resisting character of the sclerotica renders it necessary to press an instrument against it perpendicularly and with some little force, in order to perforate it readily. The vessels of the sclerotica are generally arranged in straight lines; hence their engorgement is readily distinguishable from that of the conjunctiva. The muscles of the eyeball are inserted into the sclerotica, and are consequently surrounded by the loose connective tissue between it and the conjunctiva. The **Cornea** is a firm and resisting coat, seated at the front of the ball; it is composed of numerous laminæ, separated from each other by a thin pellucid fluid in the healthy condition, but liable to become opaque from inflammation. The section of the cornea, owing to its density, and the arrangement of its layer, requires that the instruments employed should be of the best quality, and also that some caution be exercised by the operator, lest he simply separate its layers instead of passing the knife entirely through or behind them. The cornea possesses no vessels capable of carrying red blood in the healthy condition, though in inflammation its capillaries will admit it. In health, it possesses little sensibility; but, in disease, it is occasionally exceedingly sensitive, its incision having caused fainting, as occurred in the practice of Physick, of Philadelphia. Horner has also reported the same fact.

The **Choroid** is a vascular coat placed immediately within the sclerotica, and of equal extent with it, being closely fastened at its anterior margin to the corresponding portion of the latter, by a ring called the ciliary ligament. The **Iris** is set in the front margin of this ligament, so that the cornea and sclerotica may be peeled off without impairing its continuity with the choroid coat.* The arteries of the choroid coat are the two long and the short ciliary arteries. The long ciliary arteries pass one on either side, externally and internally, between the choroid and the sclerotica in the middle line of the eye. They are consequently liable to be wounded in the operations of absorption or depression of cataract, unless the needle is made to transfix the sclerotica a line or two above or below the plane of its transverse diameter, or very near to the circumference of the cornea.

The **Iris** is placed as a diaphragm behind the cornea, on a line with the ciliary ligament, and has the power of contracting and expanding, as will be referred to under the operations for cataract. The **Retina** has so little connection with operations on the eye as to require no special notice. Between the posterior surface of the cornea and the anterior face of the iris is the **Anterior Chamber** of the eye; and between the posterior surface of the iris and the front of the lens is the **Posterior Chamber**, the two communicating through the pupil, and being occupied by the aqueous humor.

The **Crystalline Humor** is a double convex lens, of which the posterior convexity is the greater. It is invested by a capsule, which is separated from it by the liquor Morgagni. In consequence of the adhesion of the capsule to the hyaloid membrane, and the contact of the ciliary processes, the lens is readily maintained in its position; all the operations upon it consequently destroy these attachments. The **Vitreous Humor** fills up the great bulk of the eye, and is directly behind the lens, the latter being received into a depression upon its anterior face. It is surrounded by the hyaloid membrane, which is strong enough to sustain it, and also prevents the depression of cataract, unless its cells are previously lacerated with the needle.

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* Horner's Anatomy, vol. ii. p. 414.

SECTION II.

DISORDERS OF THE COATS OF THE EYEBALL.

§ 1.—Conjunctivitis.

Conjunctivitis, or inflammation of the conjunctiva, resembles the inflammations of other mucous membranes generally.

Etiology.—It may arise from various causes, as simple exposure to cold, resulting in catarrh; from the presence of foreign bodies between the lid and the ball; from wounds—in fact, from any cause likely to result in the production of inflammation elsewhere.

Symptoms.—The symptoms are as follows: The patient experiences pain in the eyes of a sharp pricking character, the sensation being similar to that experienced from the presence of a foreign body in the eye, and due simply to engorgement and consequent enlargement of the superficial vessels of the conjunctiva. There is also a sense of heat and stiffness, and some intolerance of the motion of the upper lid, the lids being kept partially closed. The irritation extending to the lachrymal gland, the action of that organ becomes excessive, and there is consequently increased lachrymation, the tears overflowing and running down upon the face, while, as the secretions become changed by the inflammatory action, the tears mixed with the vitiated secretion of the conjunctiva often become acrid and irritating. The eye is red and bloodshot, and the character of this vascularity should be noticed particularly, on account of its value as a diagnostic mark, as it serves to distinguish between conjunctivitis and sclerotitis; the enlarged vessels in conjunctivitis being tortuous, reticulated in their character, and giving the appearance of a network, while in sclerotitis they are quite straight, and radiate from the cornea toward the circumference of the eye, Fig. 386.

Fig. 386.

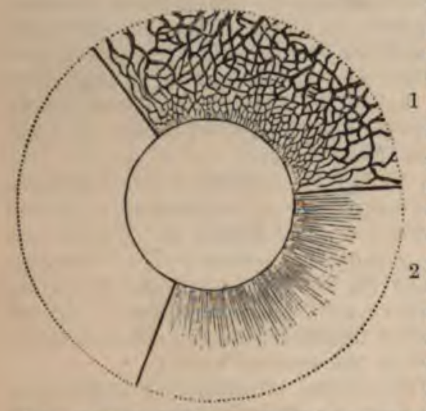


DIAGRAM TO SHOW THE CHARACTERISTIC VASCULARITY OF CONJUNCTIVITIS AND SCLEROTITIS.—1. Tortuous vascularity of conjunctivitis. 2. Straight vessels of sclerotitis. (After Wharton Jones.)

If the disease is violent, it also develops a certain amount of constitutional disturbance, this consisting in febrile reaction, with digestive and circulatory derangements.

Occasionally, instead of the simple affection just described, more marked symptoms occur, and the condition is presented which is designated as **Purulent Conjunctivitis.** In this variety an increase of the secretion of the part is first noticed; then there is a tendency in this secretion to become white, thick, and opaque at first, afterward yellow and purulent, and finally thin, acrid, and irritating; greenish in color, and presenting characters of ichor; or it may resemble sanies, the pink color being produced by the rupture of some of the superficial vessels, and the escape of the coloring matter of the blood. This thin, acrid, irritating pus, running down over the face, is apt to produce more or less excoriation or eczema of the cheek. In a short time a fullness and swelling of the lid are noticed, which increase frequently to such an extent as to result in closure of the eye, in addition to which there may be a protrusion of the folds of the mucous membrane; or this protrusion may take place before the swelling of the lids has gone on to such an extent as to close the eye, thus producing a true ectropion. The disease continuing, the inflammation may be extended from the conjunctiva to the submucous areolar tissue, which is found between that membrane and the sclerotic coat, and the effusions of serum or of lymph thence resulting may elevate the conjunctiva to such an extent that the cornea appears deeply sunken in the eye, thus producing the condition designated as **Chemosis.** If this condition continues, the cornea itself is apt to become involved, and the disease be complicated with the symptoms of corneitis, which may even go to such an extent as to result in sloughing of the cornea.

Etiology.—The causes of purulent conjunctivitis are varied, as exposure to a bright light for a great length of time; derangements in the constitution of the patient, and certain conditions of the atmosphere which are not understood. When produced, conjunctivitis is not unfrequently capable of being propagated by contagion, and will consequently often sweep through the entire wards of a hospital.

Diagnosis.—The tortuous character of the blood-vessels and their superficial position generally render the diagnosis of conjunctivitis easy.

Treatment.—The treatment of simple acute conjunctivitis is based upon general principles. Antiphlogistics are imperatively demanded if the patient has a good constitution, and, if he is plethoric, they may be carried with advantage to a marked extent. Where the attack is violent under these circumstances the treatment must also be prompt, local bleeding, by means of leeches, being resorted to, and purgatives and diuretics freely administered, especially the saline cathartics, while cold water is constantly applied over the closed lids by means of wet cloths.

Much advantage will also be derived, after the first few days, from the use of astringent collyria. As a general rule, a solution of any of the astringent salts, such as sulphate of zinc, acetate of lead, etc., of the strength of half a grain to the ounce of distilled water, will make a collyrium suitable to begin with; but the acetate of lead must not be used in cases which are complicated with ulceration of the cornea, as there will result from its use a white deposit of carbonate of lead in the ulcer, which may lead to the production of a corneal speck. Much comfort will be derived at first from the cold water dressing applied over the closed lids, as well as from the application to the ball of mucilaginous washes, as the mucilage of the pith of sassafras. When the disease becomes chronic, more stimulating applications are demanded, and the nitrate of silver may be applied of the strength of one-quarter or one-half grain to the ounce of distilled water.

Purulent Conjunctivitis will require a more active treatment, and here advantage will be found from using, from the first, a stronger solution of nitrate of silver—say a grain or a grain and a half to the ounce—with the view of modifying the action of the diseased mucous membrane. Advantage will also be frequently derived from painting the inner surface of the lids with a pencil dipped in a still stronger solution of the nitrate of silver, say six or eight grains to the ounce. When there is marked chemosis, the patient will often be benefited by making punctures in the conjunctiva, with a view of allowing the effused serum to escape, or by applying a few leeches directly to the conjunctiva, at the internal canthus.

Gonorrhœal Ophthalmia.—Gonorrhœal Ophthalmia, a very high grade of purulent conjunctivitis, is produced by the contact of gonorrhœal matter with the conjunctiva. That such a disease may be produced in this manner should always be borne in mind by the surgeon, when treating gonorrhœa, the patient being warned of the possibility of this, that so formidable a disease may thus be prevented. Gonorrhœal ophthalmia is very violent in its grade, sometimes running its course and resulting in total destruction of the eye, if not promptly met, in from twenty-four to forty-eight hours; but, except in its degree and cause, it is very similar to ordinary purulent ophthalmia.

Gonorrhœal ophthalmia being a peculiarly violent grade of conjunctivitis, requires to be treated very promptly, in such a manner that the specific inflammatory action shall be changed and another substituted. The lids, therefore, should be thoroughly everted, and, their inner surface having been well cleansed by wiping them with a piece of moist soft sponge, they should be painted with the solid stick of nitrate of silver, so as to form a delicate white film over their surfaces; then water should be freely squeezed on them from the sponge, so as to wash off any of the free caustic, after which they may be allowed to come in contact with the eyeball. This application, instead of adding to the pain, often gives prompt relief, with an amelioration of the symptoms, and may be followed next day by a strong collyrium of thirty grains of the nitrate to the ounce of water, a portion of which may be dropped into the eye, or the lids painted with it by means of a camel's-hair pencil. By these means there is some hope of arresting the progress of the complaint, which otherwise, in a few hours, is liable to result in sloughing of the cornea and destruction of the eye, as has been shown in many melancholy instances.

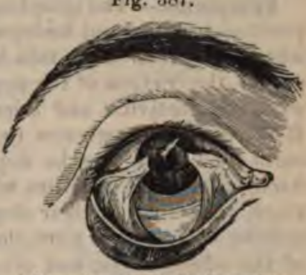
Scrofulous Conjunctivitis.—This modification of conjunctivitis, which is met with in children of the tuberculous diathesis, among the poor and in the inmates of asylums and hospitals, is much the same in its symptoms as the ordinary inflammation of the conjunctiva, above described; but there is a greater disposition to febrile reaction. The lids, in this instance, are nearly always much tumefied, with a congested state of the vessels; hence, as the upper lid moves over the inflamed ocular conjunctiva, it causes great irritation, and the patient, particularly if a child, turns upon his belly and buries his face in the pillow, or covers it with his hands, to aid in keeping the eyes closed. The muscles of the face, and particularly the orbicularis palpebrarum, are also violently contracted, so as to cover the ball. The pus secreted by the conjunctiva, when the inflammation is of a high grade, is generally very irritating, and, running over the face, produces eczema and excoriation. The corneal conjunctiva is also apt to be involved in this form of conjunctivitis, in consequence of which ulceration of the cornea frequently supervenes, the cicatrix left by the ulcer, should it heal, being slightly depressed, and presenting more or less opacity of the cornea, thus creating what the vulgar call a "feather on the sight." As the eyes are generally kept closed during the day, though sometimes more open at night, **photophobia**, or intolerance of light, has long been regarded as the cause, and presented as a symptom, of this form of conjunctivitis and ulcer of the cornea. There is, however, no anatomical connection between these coats and the retina, and it is probably incorrect to explain the closure of the lids as due to an effort to exclude the light. When a particle of sand is introduced into the eye there is a marked disposition to close the lids, and here it is certainly due to an effort to prevent the friction caused by the motion of the upper lid. In ulceration of the cornea the friction of the lid is also the main source of the suffering, and it is, doubtless, the same result that induces the child to keep the lids persistently closed in this variety of conjunctivitis.

Scrofulous ophthalmia is to be treated by means of those constitutional measures appropriate in ordinary cases of the tuberculous diathesis, tonics, stimulants, and chalybeates being resorted to instead of antiphlogistics, while the local treatment is to be carried out upon the same principles as *the other* forms of conjunctivitis, being proportioned in activity to the grade of the complaint. Great relief is to be obtained from everting the upper lid, cleansing it, and then applying, with a camel's-hair pencil, a solution of the nitrate of silver, grs. v to the ounce of water.

§ 2.—Pterygium.

The **Pterygium**—πτερυξ, a wing—is a varicose excrescence, or enlargement of the vessels of a portion of the conjunctiva, accompanied with hypertrophy and thickening of the membrane itself, which is generally triangular in shape, and found in the inner corner of the ball, as well as occasionally on its outer margin, or sometimes in both points, Fig. 387, the apex of the triangle in either case presenting toward the cornea. This condition may result from any of the chronic forms of conjunctivitis, and may be removed by extirpation, with a pair of curved scissors, Plate VIII. Fig. 17, or by cutting it across transversely, and thoroughly cauterizing the wound with the solid stick of the nitrate of silver, so as to close the vessels, and cause the portion of the pterygium, which is on the cornea and impairs the sight, to disappear by atrophy.

Fig. 387.



A front view of a Double Pterygium.

§ 3.—Sclerotitis.

Sclerotitis, or inflammation of the sclerotic coat of the eyeball, is sometimes called rheumatism of the eye, or rheumatic ophthalmia. It is found to follow upon changes in the condition of the atmosphere, and is sometimes due to extension of inflammation from some neighboring tissue, as from the iris or the conjunctiva. It may also be produced by wounds, or by any of the ordinary causes which lead to the development of inflammation.

Symptoms.—The symptoms of sclerotitis are as follows: There is a dull, heavy pain in the ball, which is severe and pulsatile in its character. There is pain in the temple, and tenderness of the ball upon pressure, the pain being more severe at night, and the cornea becoming hazy. There is, however, little or no increased lachrymation, unless the disease is combined with conjunctivitis, while the pupil remains unchanged, unless it is complicated with iritis.

Diagnosis.—Sclerotitis may be readily diagnosed from conjunctivitis by the character of the vascularity, as pointed out under the head of conjunctivitis. If the two diseases exist at the same time, the two varieties of vascularity will be present simultaneously and readily recognized.

Treatment.—The treatment is similar to that of rheumatism, free purgatives being administered, and combined with the use of antimonials or of Dover's powder. Wine of colchicum seeds, in the dose of ten to twenty drops three times a day, will also prove of service, though sometimes it will require to be given in large doses, say a teaspoonful three times a day, when it will be useful not only as a purge but as a sedative. The local applications should all be warm, and may consist in the warm water-dressing, applied according to the exigencies of the case. Counter-irritants are often serviceable, such as the application of small blisters to the temples or behind the ears; and advantage will frequently be derived from rubbing upon the lids the extract of belladonna, rendered thin with water, or aconitia, in the proportion of a grain to the drachm of lard; or a plaster of opium may be applied to the temple, and worn for several days; or cloths wet with a solution of the sulphate of atropia, a half grain to the ounce of water, may be laid upon the lids. These anodynes prove of service, both by allaying the pain and diminishing the flow of blood to the part.

§ 4.—Corneitis.

Symptoms.—The symptoms of **Corneitis** are haziness of the cornea; a disposition to increased lachrymation, from its connection with the conjunctiva, which is spread as a thin layer over its front lamina; intolerance of light, and of the friction of the upper lid; while it is not unfrequently complicated with conjunctivitis and sclerotitis, all their symptoms being also present. If the disease progresses to any extent, it may result in a true ulcer of the cornea, or there may be deposits of lymph in the structure of the cornea itself, producing opacities which have been designated by various appellations, according to their degree. When very slight, it is designated as a *nebula*, this being a mere cloudiness or circumscribed haziness in the vision of the affected eye, and often requiring some care on the part of the surgeon to perceive it. A thick opaque spot in the cornea, such as results from the healing of a corneal ulcer, is designated as *leucoma;* and when there are vessels running over the surface of the cornea, to communicate with a spot of opacity somewhere on the cornea itself, the condition is designated as *pannus*.

An amount of lymph greater than that in a leucoma, and which produces a distinct white spot, is designated as *albugo*.

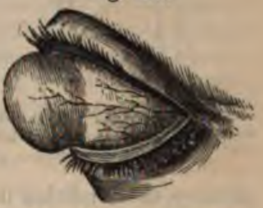
These deposits of lymph in the substance of the cornea are very difficult to relieve, though much may be done in the way of prevention by care in the treatment of the early stages of the corneitis and by cauterizing, with the nitrate of silver, any ulcers that may form upon the cornea.

Treatment.—Corneitis, being accompanied most frequently with conjunctivitis, requires very much the same treatment as was directed for simple inflammation of the conjunctiva, great attention being given to the formation of the little blisters or abscesses which appear beneath the conjunctiva covering the cornea, and are the commencement of the corneal ulcers. As soon as an abrasion of the corneal conjunctiva is seen, or an ulcer which is only superficial shows itself, it should be *lightly* cauterized, in order that it may heal under the eschar or film thus created, which will protect the surface from the irritation of the tears; while, at the same time, the lids should be kept closed by tying up the eye, or by applying a strip of adhesive plaster to the upper lid and fastening the other end to the cheek. When it is promptly met, an ulcer of the cornea will often heal without creating opacity. Should, however, an opacity unfortunately form, it is to be treated by such applications as will stimulate the vessels of the part, and favor the absorption of the lymph that causes the whiteness of the spot. The popular remedy of dropping sugar-house molasses into the eye is not a bad one, and acts simply as a stimulant. Benefit has also been derived from the direct application to the spot of red precipitate ointment, by means of a camel's-hair pencil; from the use of a collyrium consisting of a half grain of corrosive sublimate dissolved in an ounce of water, applied by means of a camel's-hair pencil, or from one of nitrate of silver, in solution, of six or eight grains to the ounce. Fumigation with the vapor of hydrocyanic acid, by means of a glass bottle with a neck so shaped as to fit the eye, has also been recommended, and may prove useful as a stimulant. At one time the sulphate of cadmium was supposed to possess peculiar efficacy in removing opacities of the cornea; but personal experience has not shown that it has any more power than the sulphate of zinc.

The cure of albugo and of leucoma has been attempted by excising the outer layer of the cornea in order to allow the applications to be brought directly in contact with the lymph, the spot being afterward cauterized with the nitrate of silver; but this treatment has been very generally unsuccessful.

§ 5.—Staphyloma.

Fig. 388.



A side view of Staphyloma.

As a consequence of various affections of the cornea or of the interior of the eyeball, the cornea becomes prominent, projects beyond the lids and creates an unsightly deformity, besides giving rise to considerable irritation from the fact that it collects on its surface the little particles of dust which are constantly floating in the atmosphere. This condition is designated as staphyloma—ςταφυλη, a grape—from its conical or globular form, Fig. 388.

Etiology.—The causes are various. It may be a consequence of inflammatory action in the globe resulting in effusion, or in softening of the vitreous humor; or it may ensue on dropsy of the aqueous humor, the pressure of which causes the cornea to protrude; but frequently this condition is the result of the morbid alterations in the cornea already stated. It is generally accompanied with opacities of the cornea more or less dense, and the patient suffers from loss of sight as well as from the irritation consequent upon the complaint.

Treatment.—The treatment in such a case is simple; nothing curative can be effected, but much relief may be obtained from evacuating the humors of the eye, as the patient loses nothing by the operation, his sight being already destroyed, while he gets rid of the deformity, and of the suffering entailed by the constant irritation of the eyeball from the foreign matter which adheres to its prominent surface.

The operation may be effected by slicing off the more prominent parts of the staphyloma, and allowing the humors to be thus gradually evacuated; or the same end may be attained by a simple puncture with a lancet.

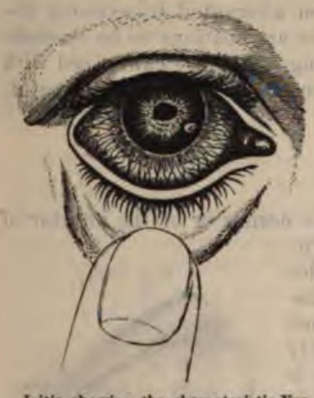
An artificial eye may be subsequently employed, and if well fitted, will follow the motion of the stump, and greatly diminish the deformity left by the evacuation of the humors of the ball.

§ 6.—Iritis.

Inflammation of the iris, according to the law of nomenclature above alluded to, is termed **Iritis.**

Etiology.—The causes are numerous, and are to be found in some peculiar condition connected with secondary syphilis, which is perhaps the most frequent origin of the complaint; or it may be created by exposure to cold; by blows; by wounds made during operations upon the eye, as in the operation for cataract; or it may result from a simple extension of an inflammation set up in some other coat, and thus be a consequence of conjunctivitis, of corneitis, sclerotitis, or choroiditis.

Fig. 389.



Iritis, showing the characteristic Vascularity, the Lymph on the Iris, and the contracted irregular Pupil.

Symptoms.—When iritis is developed by any of these causes the symptoms are as follows: There is violent pain in the eye, this pain being deeply seated, and referred to the course of the optic nerve or to its origin in the brain, in addition to which, changes in the color of the iris are soon apparent, the tint appearing darker than is natural, owing to the afflux of blood to the tissue. There is also often a change in the shape of the pupil, in consequence of the irregular contraction of its muscular fibres, and there is usually noticeable a zonular redness around the cornea, this zonular redness being of that variety of vascularity which is characteristic of sclerotitis, Fig. 389.

The effects of the inflammation may also show themselves in a way that produces serious consequences; thus the iris may become adherent at its pupil by the organization of the effused lymph, either posteriorly to the capsule of the lens, creating a condition which is described as *synechia posterior*, or it may adhere anteriorly to the cornea, and develop the condition designated as *synechia anterior*.

Inflammation of the iris may run on to such a grade as will result in suppuration, the effused pus escaping into the anterior chamber, and causing various degrees of yellowness in the color of the aqueous humor, to which the name of **Hypopion** has been given. If the effusion of pus is very free, it may produce a bulging of the cornea forward, and result in the establishment of staphyloma.

Diagnosis.—The diagnosis of iritis is generally easy, the change of color being the most marked symptom. It is, therefore, very important to bear in mind the fact that there may be peculiarities in the color of perfectly healthy eyes, which, to a certain extent, would simulate the disease. Thus, an individual may naturally have one eye gray, and one slightly greenish; and, under these circumstances, the surgeon would sometimes fall into error if he depended for his diagnosis upon the color of the iris alone. Still, as a general rule, where there is a difference between the color of the two irides, particularly if the pupil is irregularly contracted, and the other local and constitutional symptoms of the disease are present, the case may be safely set down under the head of iritis.

Prognosis.—The prognosis of iritis depends very much upon the period at which it comes under the surgeon's observation. If lymph has been effused, if the pupil is irregularly contracted, and particularly if the condition of things is such as to lead the surgeon to suspect either synechia anterior or synechia posterior, the prognosis will be unfavorable. If the case is seen at an earlier stage, and before there is reason to suspect the effusion of lymph, the prognosis will be much more favorable.

Treatment.—The treatment of iritis is precisely that which would be proper in the treatment of inflammations of any other highly vascular and important structure, as it must be of the most active antiphlogistic character. The inflammatory process here, as elsewhere, always presents an increased vascularity, which, if left unchecked in the iris, will result in an effusion of lymph, the dangers of which have been pointed out, if it does not result in an effusion of pus. The treatment should therefore be commenced by the administration of a brisk purge; and this, to be serviceable, should contain a mercurial, so as to modify the general secretions. The old practice of salivating, under the idea of breaking down the effused fibrin, is now generally regarded as incorrect and useless.

To alleviate the pain from which the patient suffers, opium may be resorted to, this being also indicated on account of the sedative, and consequently antiphlogistic properties of the drug. But the most important measure is the local use of the sulphate of atropia in solution, which, (see Cataract,) while it serves to relieve the pain, also acts by directly diminishing the inflammatory action, upon the old principle, "Ubi irritatio ibi affluxus est." The solution of atropia answers another important point, as, by relaxing the circular fibres of the iris, it allows the radiating fibres to contract, and thus, producing dilatation of the pupil, removes, in a great measure, the risks of the adhesion of its edges, and, by narrowing the iris, leaves less tissue to be acted on by the disease.

Should it happen, either from neglect or unskillful treatment, or notwithstanding good treatment, that the disorder terminates in an obliteration of the pupil by the adhesion of its edges, and the patient is thus left blind, an operation will become necessary, in order that, by the formation of an artificial pupil, the rays of light may be transmitted to the retina. In selecting the portion of the iris in which the artificial pupil is to be made, care should be taken to choose that which is directly posterior to some portion of the cornea that is clear, if any opacities exist, as hereafter described.

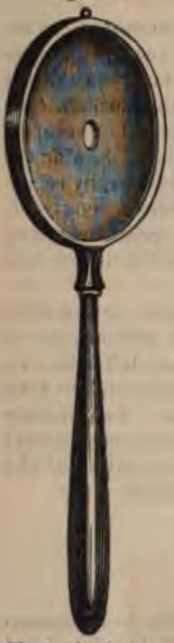
§ 7.—Choroiditis and Retinitis.

That the choroid and retina, as tunics of the eye, are liable to inflammation, and to the changes of function and structure induced by disordered circulation and nutrition, cannot be doubted, especially in view of the great vascularity of the choroid coat, and the proximity of the retina to it. Hence choroiditis and retinitis, or choroido-retinitis, are very generally spoken of by ophthalmologists. How to recognize the disorder of deep-seated tissues like the choroid or retina, has always been the difficulty; and the results of congestion and inflammation in these coats have therefore, doubtless, given rise to the varied conditions of defective vision hitherto spoken of as **Amaurosis**, (*αμαυρος*, obscure,) this term signifying loss of sight, without any change of structure to an ordinary observer. Amaurosis has, therefore, long been a general term applied to all cloudiness or imperfection of vision not evidently due to opacities of the lens or of the cornea. The discovery of our ability to inspect the interior of the eyeball, and the invention of the ophthalmoscope having enabled the surgeon to investigate the diseased and natural condition of the interior structure of the eye, these disorders are now more certainly recognized, and their treatment reduced to something like scientific accuracy. Without entering into the details of either, it must suffice, in a work of a general character, merely to allude to such points as will show the present conditon of surgical knowledge, and refer the reader desirous of more specific instruction to the varied treatises and monographs on ophthalmic disorders.

The **Ophthalmoscope**, as now formed, enables the observer to recognize not only the condition of the choroid and retina, but also of the lens and vitreous humors of the eye; and the disordered conditions thus shown may be best alluded to in connection with the use of this instrument.

After Cummings, of England, had demonstrated that it was possible to *see* the retina of the healthy eye during life, his investigations led Helmholz, of Königsberg, in 1851, to suggest an apparatus by which we could examine the retina by artificial light, after which Ruete, of Vienna, in the following year, invented the plan of illuminating the retina by means of a concave mirror with a hole in its centre, through which the observer looked, this being the essential principle of most of the ophthalmoscopes at present in use, a very great variety of which have since been produced, some of them being exceedingly complicated. Of these instruments, it is generally conceded that the simpler forms are not only more economical, but of the greatest practical utility. That which is regarded with most favor in Great Britain and this country is the pattern generally known as that of M. Anagnostakis. It consists of a small, circular, concave mirror, of about ten inches focus, having a hole bored in its centre, and mounted with a shell or metal rim and handle, Fig. 390, and of a simple, biconvex lens, Fig. 391, of about two inches focal length without mounting. Both mirror and lens should be of good quality, in order to obtain the best results.

Fig. 390.



The opening in the mirror is represented as too large.

Fig. 391.

As the rays of light from an illuminated retina are convergent, they are made to diverge and come to a focus on the observer's retina, by his holding a concave lens between the patient's eye and his own, and regulating the focus by moving it from or toward the eye of the patient, Fig. 392.

Mode of Examination by the Ophthalmoscope.—If the patient's eye is tolerant of light—and if it is not, the ophthalmoscope cannot be safely used—dilate the pupil by the use of a few drops of the solution of the sulphate of atropia, as directed in cataract. Then seating him, in a dark room, near a

Fig. 392.

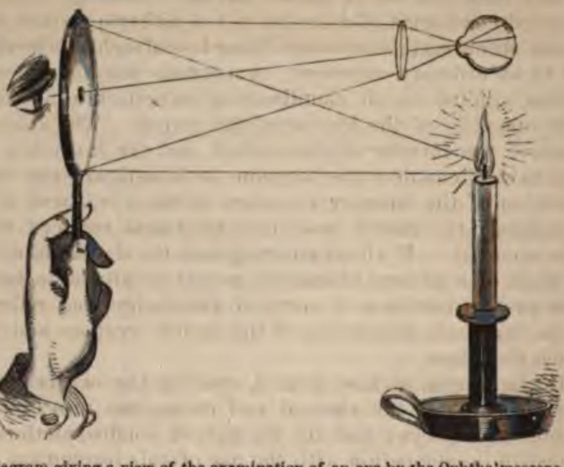


Diagram giving a view of the examination of an eye by the Ophthalmoscope.

table, so that the light may be placed by the side of his head, (affected side,) the surgeon holds the mirror in his right hand, before and near to his own eyes, inclining it so that he may cast the rays of light which it reflects directly into the patient's eye. Then, with his left hand adjusting the concave lens so as to bring the rays to a focus, he will have a good view of the interior of the patient's eyeball. Sometimes it is useful to shield the patient's eye from the light by directing him to hold a fan or screen at the side of his head, between it and the light. A steady light is important—gas being better than a candle or lamp.

Appearances of the Healthy Eye.—The interior of the healthy eye of man is of a red or orange color, being more pink in the fair, and more orange in the dark complexions, presenting throughout, in both, the color of the choroidal vessels, with the branching vessels of the retina here and there on the field. The vessels of the retina are to be seen emerging from the entrance of the optic nerve, which is the yellow spot usually seen, this being free from vessels. If the choroid is congested, the bright, blood-red color of the interior will be of a marked character. If the retina is diseased, its vessels will be enlarged and tortuous, or there may be spots of extravasation of blood seen upon it in clots, or opaque spots of varied degrees of extent and density. To appreciate these changes, the student must carefully examine, and become familiar with, the appearance of the healthy eye, and make allowance for the congestion caused by the examination.

Fig. 393.

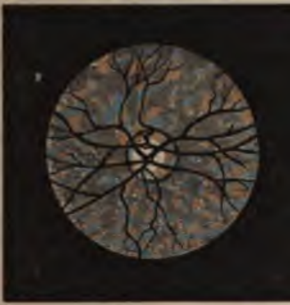


Fig. 394.

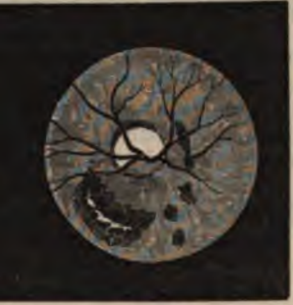


Fig. 393.—A representation of the normal condition of the retina, as shown by the Ophthalmoscope. On the centre there is seen the papilla of the optic nerve, with the arteria and vena centralis retinæ—which may be distinguished by their color. (After Schauenberg and Von Trizt.)

Fig. 394.—Black spots upon the retina, probably the remains of effused blood, and resulting from injury produced by the iron point of a top, which perforated the iris and cornea. (After Von Trizt.)

Abnormal conditions of the crystalline lens, as in commencing *cataract*, may also be thus readily recognized. According to Desmarres, "there is no opacity of the crystalline body, however small and slight it may be, that cannot be detected by the aid of the ophthalmoscope." The importance of discriminating between the very earliest stage of incipient cataract and *amaurosis* cannot be over-estimated, yet it is precisely at this very earliest stage that the diagnosis is sometimes most difficult, or even impossible, except with the help of this instrument.

Disease of the Vitreous Humor, as opacities due to the presence of lymph, or intra-ocular hemorrhages, as well as various opaque or dark floating bodies, the precise nature of which can as yet only be conjectured, but which are supposed to be altered blood by Dixon, may also, it is said, be satisfactorily investigated by the ophthalmoscope. The only well-known Cysticercus has been detected, in several cases of partial or complete blindness in the vitreous humor, by Von Græfe, and one case is reported by him in which this parasite, after its recognition by the ophthalmoscope, was removed through an incision in the sclerotic coat. The patient's sight was greatly benefited for the time, but it was feared that chronic choroiditis, which was apprehended at the time of the report, might prevent the ultimate success of the operation.

Morbid Conditions of the retina, as retinitis, congestion, or anemia, accumulations of liquid behind the retina causing it to separate from the choroid as in posterior hydrophthalmia, opacities and structural alterations of the retina, can also be only satisfactorily diagnosed by means of the ophthalmoscope.

Fig. 395.

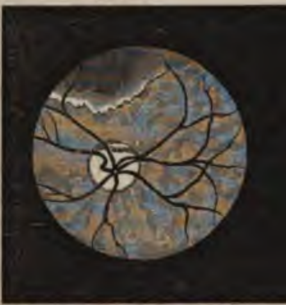


Fig. 396.

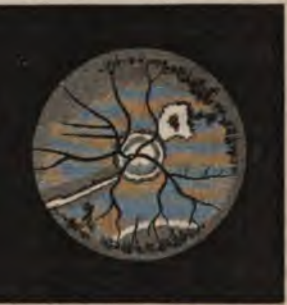


Fig. 395.—The ophthalmoscopic appearance of partial choroiditis—the gray portion appearing bloodless, with probable exudations. On the margin are seen evidence of severe congestion, with spots of effused lymph. (After Von Trizt.)

Fig. 396.—Large masses of effused lymph, seen in the eye of a female blind for six years. There was also diseased pigmentum nigrum and atrophy of the retinal blood-vessels. (After Von Trizt.)

On account of the normal transparency of the retina, congestion, exudations of lymph, and some other anomalous conditions of the **Choroid** can be recognized in the same manner.

Figs. 395 and 396 illustrate some of these changes, and show the organic disorders, often connected with loss of vision, resulting from diseases of these deep-seated coats, most of these changes being unappreciated before the discovery of the ophthalmoscope.

SECTION III.

OPERATIONS ON THE EXTERIOR OF THE EYEBALL.

Anatomy of the Muscles of the Eyeball.—The eyeball is moved by six muscles—Plate XII. Fig. 2—two of which are oblique and four are straight. The straight muscles all arise from around the optic foramen, and are inserted by broad and thin tendons into the sclerotic coat of the eye about three or four lines from the cornea, Plate XII. Fig. 4.

The superior oblique muscle also arises from near the optic foramen, but the inferior oblique takes its origin from the nasal process of the superior maxilla at the side of the os unguis. Both are inserted into the sclerotica, about half way between the cornea and the optic nerve. Between all the muscles and the conjunctiva is found a white fibrous membrane which lines the ocular conjunctiva throughout. This membrane extends from the palpebral ligament in front as far as the cornea, and then turning backward forms a complete envelope for the sclerotica until it reaches the optic nerve, with the neurilemma of which it appears to be continuous. On the sclerotica it is very movable, and a layer of cero-cellular substance is interposed between them. At the points of insertion of the tendons, it is folded around them so as to form a fibrous sheath—Plate XII. Fig. 3—which degenerates into cellular tissue on the muscle. This membrane is designated by Malgaigne as the **Subconjunctival fascia.**

§ 1.—Strabismus.

Strabismus—*ςτραβος*, twisted—or squinting is a disorder due to a want of parallelism in the axis of the two eyes, which is kept up by the defective action of some of the muscles of the ball. The muscles involved are most frequently the recti, although the oblique muscles are also at times affected. The squint generally depends upon excessive contraction of *one* of the muscles, and this is usually accompanied by preternatural relaxation of its antagonistic muscle.

Varieties.—If the contraction affects the internal rectus muscle, the complaint is called a *converging squint*, (strabismus convergens,) the affected eye being turned inward toward the inner canthus. The opposite condition is designated *divergent squint*, (strabismus divergens,) and in this the internal rectus is relaxed, while the external is preternaturally contracted, thus causing the ball of the eye to roll toward the external canthus.

If the oblique muscles are affected, the eye may be rolled inward and upward, or outward and downward; but these varieties are more rare.

Etiology.—The causes which create the squinting are various. Thus, it may arise from congenital weakness of sight; from congenital malformation; from imitating others who squint; or be caused by looking too steadily and too frequently at small objects; by irritation of the stomach and bowels; by worms, etc.

Treatment.—The treatment of strabismus is both constitutional and local, and on account of the neglect of the constitutional treatment, many local remedies—as operations for its relief—have failed, which which would otherwise have been perfectly successful; a general treatment should, therefore, precede any operation. If the cause is found to be irritation of the stomach and bowels, this condition must be attended to; if due to worms, they should be removed by means of anthelmintics; and if the patient is debilitated and anemic, the use of chalybeates and tonics is indicated. By thus improving the patient's general health, we may anticipate an improvement in the condition of that muscle of the ball upon which the complaint depends, particularly when the excess of action on one side is the result of paralysis of the opposite muscle.

Advantage will also be derived from exercising the motions of the eye, as the muscles of the eyeball may be strengthened and improved by judicious exercise, precisely as those of other parts of the body. The patient should, therefore, stand before a mirror, and, covering the sound eye with his hand, endeavor to look straight at it, as he can readily do. Or, in children, the same result may be obtained by placing two gilt balls—fastened behind the head upon a semi-circular wire—near the external canthus of the eyes, and inducing the little patient to look at them. When it is evident that the strabismus is produced by paralysis of one of the muscles of the eye, such means must be employed as are likely to correct this condition; thus, a blister of small size may be put upon the temples, and the raw surface dressed with a cerate consisting of a quarter of a grain of strychnia to an ounce of simple cerate.

Electricity has also been said to prove serviceable, particularly that form of electro-magnetism which is produced by Faradian currents created by the revolution of coils of wire before the ends of a horseshoe magnet. Such

PLATE XII.

OPERATIONS PRACTICED ON THE EYEBALL.

Fig. 1. Excision of a Pterygium by the Bistoury. 1, 2. The fingers of the assistant who controls the lids. 3. The forceps seizing the pterygium, and raising it from the eyeball, while it is excised toward the internal canthus by the bistoury introduced beneath it. *After Bourgery and Jacob.*

Fig. 2. A Vertical Section through the External Face of the Right Orbit, showing the Muscles of the Right Eye. 1. The eyeball. 2. Levator palpebræ superioris muscle. 3. Rectus superior. 4. Rectus externus. 5. Rectus inferior. 6. Inferior oblique muscle near its insertion. 7. The point of the origin of the recti muscles near the optic foramen. The eyelids are seen in position. *After Bernard and Huette.*

Fig. 3. A side view of the Sheaths of the Muscles of the Right Eye. 1. The eyeball. 2. The sheath of the levator palpebræ. 3. Sheath of rectus superior. 4. Sheath of rectus externus. 5. Sheath of rectus inferior. 6. Sheath of inferior oblique. *After Bernard and Huette.*

Fig. 4. A front view of the Eyeball, showing the insertions of the Ocular Muscles into the Sclerotica, and their tendinous expansion upon the ball. *After Bernard and Huette.*

Fig. 5. A front view of Hays' Operation for Strabismus, as practiced on the left eye. The sound eye has been covered by a handkerchief, and the eyelids of the squinting eye distended by the spring speculum placed outside of the tarsus cartilage, while the surgeon, raising a fold of the conjunctiva near the internal canthus, divides it vertically with the scissors. The muscle, being thus exposed, is seized and divided as shown in Figs. 7 and 8. *After Nature.*

Fig. 6. The Operation of Sedillot. 1. The speculum applied inside the lids. 2. A double hook inserted into the ball to steady it. 3. Forceps raising a fold of the conjunctiva. 4. Division of the conjunctiva by slightly curved scissors. *After Bernard and Huette.*

Fig. 7. An enlarged view of the Operation of Hays, showing the division of the muscle. *After Nature.*

Fig. 8. The Muscle, as raised on a Hook. *After Bernard and Huette.*

Fig. 9. Division of the Muscle in Sedillot's Operation; the chief difference being in the scissors and hook employed for this purpose. *After Bernard and Huette.*

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Fig. 1

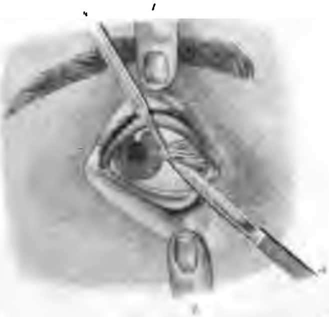


Fig. 3

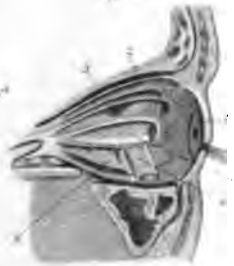


Fig. 2

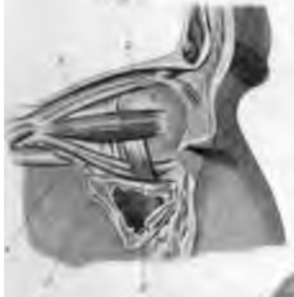


Fig. 5

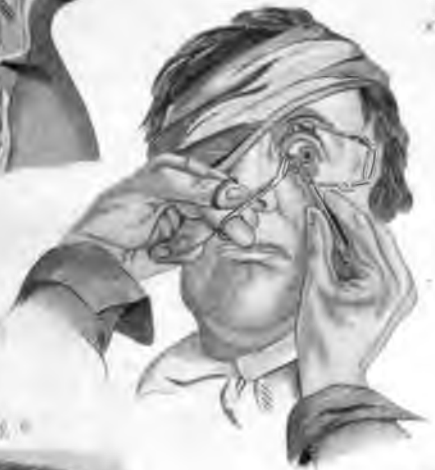


Fig. 4

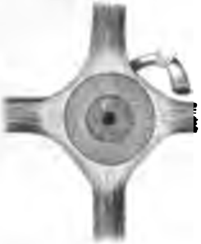


Fig. 6

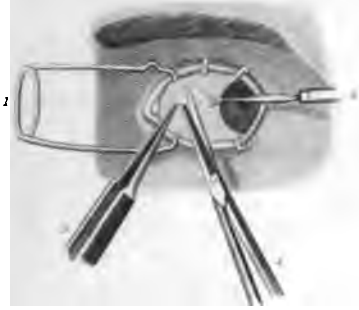


Fig. 8

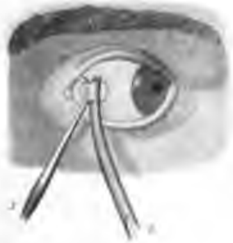


Fig. 7

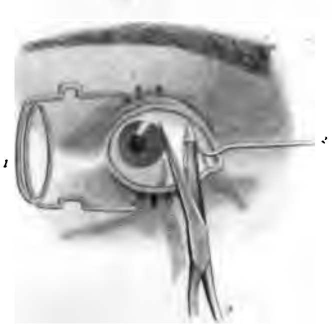
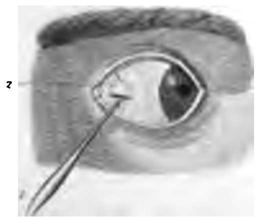


Fig. 9



[illegible]

a current may be passed daily through the temples; but it is necessary to use it with caution, particularly in the case of children, where the fright produced by the incautious application of it, by inducing violent struggles, screaming, etc., might result in an afflux of blood to the part, the pernicious influence of which would more than counterbalance any good that would follow the application.

But when the careful employment of these means has failed, and the surgeon is satisfied that the squint is caused by a direct and continuous contraction of one of the muscles, he may derive benefit from an operation.

Operation for Strabismus.—The credit of suggesting the operation for the relief of squinting has been generally assigned by European writers to Stromeyer, but in the United States it is well known that he had been anticipated, and the operation performed many years before his account was published, by Gibson,* of Philadelphia, who in 1818 operated in four cases, though he was subsequently induced to lay it aside from the opinion of Physick being adverse to it, the latter gentleman fearing that it would endanger vision. To Stromeyer, however, is certainly due the credit of having brought the operation into general notice in 1838, and to Dieffenbach belongs the honor of having established its success beyond a doubt. In the United States, the operation was subsequently performed by Willard Parker, of New York, in 1840, and by Pancoast, A. C. Post, Gross, Detmold, and Dixon, shortly afterward, who in several papers called attention to its utility. Since then, it has been repeated by nearly every surgeon. As the advantages of this operation appear, however, to have been doubted by many, in consequence probably of the failures which have resulted from imperfect operations, or those injudiciously performed, I would state that most of the evidence continues to be favorable to its performance, in proper cases.

Various modes of operating have been employed by different surgeons, though all have the same object, to wit, the division of the contracted muscle, and only differ in the means employed.

Stromeyer controlled the movements of the eyeball by a fine hook inserted into the conjunctiva, elevated a fold of the same membrane by forceps, incised it with a cataract knife, and, raising the muscle upon a hook, divided it with scissors or a curved knife.

Dieffenbach elevated the upper lid with Pellier's speculum, depressed the lower lid by the finger of an assistant, drew the eyeball outward by a fine hook in the conjunctiva, elevated a fold by another fine hook, incised the conjunctiva between the hooks with curved scissors, elevated the muscle on a curved hook, and divided it with the same scissors.

Sedillot separated the lids by a spring speculum, inserted a hook into the sclerotica to steady the eye, elevated a fold of the conjunctiva with forceps, and divided it with curved scissors, Plate XII. Figs. 6, 8, 9, pursuing in the remainder of his operation the course just detailed.

There is, however, according to my observation, no necessity for a hook to fix the eyeball, and the following plan, which I have frequently practiced with success, and which is the process long pursued at the Wills Hospital for the Eye, in Philadelphia, is much more simple.

Ordinary Operation.—Close the eye, generally the soundest one, with a handkerchief or bandage, in consequence of which the affected eye becomes straight, if the case is a proper one for the operation. Then, having separated the lids by a speculum, seize a fold of the conjunctiva over the muscle half way between the cornea and the inner canthus and a little below the equator of the eyeball, with a pair of good forceps, Plate XII. Fig. 5; elevate it, incise it obliquely, not vertically, with a snip of the curved scissors; divide the fascia, if necessary, in the same way, pass a *large* curved hook, Plate VIII. Fig. 23, having a convexity at least equal to that of the ball, beneath the muscle from below upward, and divide it with the same scissors.

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* Principles and Practice of Surgery, vol. ii. p. 375. Philadelphia, 1841.

Seizing the conjunctiva in this manner is quite sufficient to steady the eye, and the subsequent steps of the operation are equally simple.

After-Treatment.—A little cold water and a fine sponge usually suffice to check the slight hemorrhage resulting from the incision, when, if the muscle has been thoroughly divided, the patient will generally be able to keep the eye straight. The eye should then be left open, bathed frequently with cold water, and the patient directed to use it, while the other is kept closed. The use of a simple collyrium will generally relieve the conjunctival injection in a few days, when both eyes may be used, so as to acquire a proper parallelism of vision; but, occasionally, a little fungous growth results from the incision, and may require excision or to be removed by caustic, though it is not common, except where the conjunctiva has been very freely divided.

Guerin has proposed a subconjunctival division of the muscle as being least likely to permit that protrusion of the ball which is occasionally noticed when the primary incisions have been very free; but as the ordinary operation does not induce this when properly performed, and insures the more perfect division of the fibres of the muscle and its tendon, the plan has nothing specially to recommend it.

Operation of Tavignot.—The object of all the operations performed for the relief of strabismus being to bring the pupil to the centre of the orbit by elongating the contracted muscle, little or no regard is paid to the condition of that of the opposite side, which, from being kept constantly upon the stretch, is unable to resist the action of the muscle which causes the squint. To obviate this, Tavignot has proposed a new operation, the object of which is to shorten the muscle which is elongated, instead of elongating that which is contracted, as in the ordinary operation; he therefore operates as follows:—

First Operation.—The longest muscle—say the external rectus in convergent strabismus—being exposed in the usual manner, a blunt hook, with an eye at its extremity, is passed underneath the muscle so as to detach it from the globe of the eye by lifting it up. The hook being then carried forward, so that its concavity may embrace the muscle at a little distance from its *aponeurotic expansion*, a silk thread is passed through the eye of the hook, and the latter removed, so as to leave the ligature under the muscle. By a double twist of the ends of the thread, a simple and resisting knot is formed, which is then tightened, and one end of the ligature cut off, the other being brought out at the corresponding angle of the eye and fastened by a little piece of plaster on the edge of the orbit.

The first effect of this ligature is to render the lateral fibres of the muscle more central, and thus induce its shortening; while the second is to develop such an adhesive inflammation as not only permanently fixes the abnormal juxtaposition of the muscular fibres, but also creates an adhesion of the muscle to the sclerotic coat. As the ligature is only a temporary application, and not intended to divide the muscle, it should be removed at the end of the second or commencement of the third day, by drawing gently on the end which remains.

Should this operation not prove sufficient, as would, perhaps, be found to be the case in very severe strabismus, another is to be performed thus:—

Second Operation.—The hook being passed under the muscle, as in the first operation, the ligature is to be passed not directly under the muscle, but under the hook, so as to embrace the *muscular expansion*. Then, in order to see if the globe is perfectly restored to its natural position, a different colored thread should be passed through the loop of the ligature, and a single knot formed in the first ligature so as to constrict the muscle, when the hook may be withdrawn, and the eye left to itself. If the globe is now not brought sufficiently back, a larger amount of muscular tissue must be embraced by the ligature; but if the globe is brought too far round, then a less amount must be inclosed—the ligature that constricts the muscle being in either case relaxed as soon as possible. Owing to the position of the colored thread, this relaxation can be readily accomplished by pulling one end of the ligature with one hand, and drawing the thread which was passed through its loop with the other, by which manœuvre the knot will be made to yield readily. Then, passing the hook again under the muscle, recommence the operation, keeping in mind the experience just obtained as to the amount of the muscle to be constricted.

Remarks.—The principle of this operation is so evident as to require no further explanation.

§ 2.—Extirpation of the Eyeball.

When, from malignant disease or other causes, it becomes necessary to remove the entire eyeball, it is of great importance that as much of the upper lid should be preserved as is possible, in order to protect the cavity of the orbit from foreign matter as well as to favor the subsequent use of an artificial eye.

Ordinary Operation.—The patient being either seated or lying down, pass a large curved needle, armed with a strong ligature, through the ball, as far back as possible; remove the needle, and tie the ligature in a loop, so as to give the assistant the control of the tumor. Then, incising the lids at the external commissure, if the globe is much enlarged, but not otherwise, rapidly dissect the lids from the ball by cutting through the reflexions of the conjunctiva. Now passing the scalpel or straight bistoury along the os planum, carry it around the orbit so as to divide the attachments of the two oblique muscles, and, on approaching the external canthus, remove, if requisite, the lachrymal gland. Then, without drawing too strongly upon the ligature, lest injury be done to the origin of the optic nerve, put the four recti muscles upon the stretch, and, passing the knife to the bottom of the orbit on its external side, free their attachments to the ball, and remove the eye, arresting the hemorrhage by cold cloths, or by lint wet with the solution of the persulphate of iron. The advantage of the ligature over the forceps or volselum, as a means of controlling the tumor, will be found in the firmness of its attachment to the ball, owing to the fibrous character of the sclerotic coat. When scissors are preferred to the scalpel, they may be employed as follows:—

Operation of Mettauer, of Virginia.—Mettauer, of Virginia, repeated Bonnet's operation in the following manner:—

The patient being in the recumbent posture, and under the influence of an anæsthetic, the eyelids were divided as usual at the external canthus, and a curved needle and ligature passed through the ball so as to retain it in position. The eye being then drawn forward, an incision was made by passing one blade of a pair of curved scissors through the conjunctiva and beneath the muscle on the inner side of the eye, as in the operation of strabismus. The four recti and the two oblique muscles being thus divided close to their insertions, the optic nerve was cut by passing the scissors around it, and the eye removed.

The dressing was simply lint wet with water.

This case, two months after the operation, and another similarly operated on by him two years previous, were well at the time of the report.

Remarks.—When cancer or other disease is limited to the eyeball, and the areolar and adipose tissue in the orbit is healthy, preference may be given to the mode of operating followed by Mettauer, as it is thorough, neat, and simple; but, in other cases, the older operation first detailed will be requisite in order to enable the surgeon to remove all the diseased structure from the orbit. The success of early extirpation of the eye in malignant disease is more marked than when it has been developed elsewhere, Robertson, of Edinburgh, having cured twenty out of twenty-three cases. This operation is not, however, so universally favorable in its results, similar growths being apt to appear subsequently in the brain, or other organs, as is generally the case in operations for malignant diseases.

§ 3.—Tumors in the Orbit.

When fibrous or other tumors in the orbit are of such a size as to forbid their extirpation through the lids, it may become necessary to divide the external canthus, dissect them out, and then unite the wound by a stitch of the interrupted suture; a piece of linen wet with cold water being the only dressing that is generally required. When tumors, and especially those which resemble scirrhus, are found upon the tarsal cartilages, their removal may be accomplished by a V incision, or in a manner similar to that spoken of under the operation for Ectropium. The bony tumors of the orbit will require careful consideration, lest the attempt to remove them involve the brain and its membranes.

SECTION IV.

DISORDERS OF AND OPERATIONS ON THE INTERIOR OF THE EYEBALL.

§ 1.—Cataract.

Cataract is that diminution or total loss of vision which is the result of certain changes produced by disease in the lens, or on its capsule, or on both. The function of the lens being to aid vision by concentrating and modifying the rays of light in such a manner that the reflected image of external objects may be fairly thrown upon the retina, it is placed immediately behind the pupil, close to the iris, and directly in the axis of vision, being surrounded by its own proper capsule, between which and itself there is said to exist a small quantity of fluid, described by anatomists as the Morgagnian fluid.

From these facts it will be perceived that should the lens and its capsule, or either of them, become opaque, and the rays of light pass imperfectly through them, or not pass at all, no impression, or a very imperfect one, will be made upon the retina. When such a condition occurs, it is easy to understand that if we could get rid entirely of the opaque lens and its capsule, and correct the imperfections of vision which its removal produces, by wearing spectacles of a similar convexity to that of the lens, sight would be restored; and this is what is actually done in the different operations for cataract.

Etiology.—The causes of cataract are various, and not clearly known; sometimes it is thought to be the result of inflammatory action, either commencing primitively in the lens, or communicated to it from the other structures of the eye. The excessive stimulus of exposure to a glaring light by stimulating the nerves of the eye, and producing inflammatory action, often induces the complaint; hence cataract is common among glassblowers and the operatives in iron founderies. Late hours employed in looking at minute objects by a dim or a glaring light have also an effect in the production of the disease; and it is sometimes found, therefore, in professional men and students, in seamstresses, in embroiderers, and the whole class of persons similarly occupied. Cataract is also not unfrequently the result of wounds, or of old age, while it is sometimes congenital; it is also found in the eyes of other animals as well as of man, being said to be not unfrequent in the eye of the calf.

Varieties.—Cataract may be of various kinds, and it is hence divided into several varieties; this division being made according to its consistence, thus creating the so-called *hard* and *soft cataracts*, the diseased lens being harder or softer than the normal one. It is also spoken of as *mature* and *immature*, while other varieties are made according to the seat of the disorder, as *lenticular*, *capsular*, or *capsulo-lenticular*. A variety also exists in which the part particularly affected is the liquor Morgagni, which, becoming thick and opaque, is hence sometimes designated as *Morgagnian cataract*.

There are also varieties which are dependent on color, the diseased lens appearing, when examined, to be *white*, *gray*, *amber-colored*, *brown*, *radiated*, etc., while other varieties are named in accordance with the contents of the capsule. If these are thin, watery, and whitish, it is called a *milky cataract;* if thicker, and jelly-like, *gelatinous ;* while, if hard or like bone in their consistence, it is termed *osseous*. Now, it is a matter of some importance to be able to diagnose between these various kinds of cataract, as the operation which would exactly suit one variety would be useless and unjustifiable in another. It will therefore be useful to detail some of the symptoms by means of which these varieties can be distinguished.

Symptoms.—As a general remark, it may be stated that most of the varieties of cataract may be detected by simple inspection, as some of them are not only readily recognized by the color and transparency of the lens, but also by its position and size.

1. **Soft Cataract** creates in the lens a prominence which does not naturally belong to it, in consequence of which it tends to project through the pupil, a condition which can be readily observed by looking at the eye sideways. The lens is here larger than natural, while in hard cataract its size is diminished, or is of the natural bulk. Soft cataracts can also be distinguished by their color, which is of a grayish hue, light, almost white, or of a slightly bluish tint, resembling the color of skimmed milk, there being in this color little or no admixture of yellow. The opacity also is not uniform, but resembles rather a cloud, being darker in some parts than in others. The soft cataract should not be confounded with the *fluid* cataract, which is much more watery in its consistence, there being in the latter a breaking down of everything like solidity in the structure of the lens. In color this variety is a dull gray, presenting an appearance which has been compared to thick oatmeal gruel, or to good thick rich cream, and in this gray there is generally more or less yellowness of color.

2. **Hard Cataract** is, on the contrary, often positively yellow, or gray and yellow combined in various proportions so as to present the various shades of brown; or it is amber-colored, or resembles wax slightly softened by heat. As a general rule, the appearances presented by cataract will be sufficient to inform the surgeon whether the lens or its capsule is involved in the disease, the capsular cataract being much whiter around its circumference than at any other part, and presenting, generally, opaque striæ, by which it may readily

be recognized. Even when the capsule alone is involved and the lens is sound, it is possible for the experienced ophthalmist to detect it, the opacity not having the same density as is seen when the latter is also involved.

Complications.—The complications of cataract consist chiefly in the opacity of the lens being combined with some affection of the iris, as adhesion; or with some loss of power in the nervous portions of the eye. Thus the same individual may have both cataract and dimness or loss of sight from an impaired condition of the retina or of the choroid coat; while the iris may be adherent to the capsule of the lens, etc. In the first of these cases it would be useless to operate, for when the obstruction was removed, and the rays of light were allowed to pass freely through and impinge upon the retina, they would find that structure totally unconscious of the impression; while, if adhesions existed between the lens and the iris, the removal of the cataract would probably induce iritis. Cataract may also be complicated with obliteration of the pupil, and with opacities of the cornea.

Diagnosis.—The diagnosis of cataract is very important, as the disease is comparatively common, and physicians in country districts, who would be unwilling to operate, are frequently called upon to express an opinion in such cases, in order that if the eye requires it, the patient may travel to some distant point to have an operation performed. Errors of diagnosis may, however, be generally avoided, and a positive opinion in regard to the existence of cataract be accurately formed by means of the ophthalmoscope, as before described, or perhaps more readily, by an inexperienced observer, by means of *Sanson's* catoptric test, which depends upon the fact that if in a darkened room a small candle is held before the healthy eye, three images or reflections of it will be seen in the ball, one being formed on the surface of the cornea, which is large and upright; one, faint and inverted farther in; and a third, upright, clearer, more distinct, and deeper in the eyeball than the inverted, but not so distinct as the first erect image. In cataract one or more of these images is always wanting, for reasons that will be presently shown.

Catoptric Test.—The formation of these three images in the healthy eye will be readily understood by a brief reference to the character of the surfaces which reflect them; thus the cornea presents a convex surface which not only transmits light, but, like all transparent bodies, reflects more or less of it, in consequence of which it acts precisely like a convex mirror; this, as is well known, giving upon its surface an erect image smaller than the object itself, and of a size diminishing as the convexity of the lens increases. When, then, a candle is held before the healthy eye, the reflection from the cornea causes the formation of a distinct image which is erect, and corresponds in its movements with the movements of the candle, thus forming the first of the three images of the catoptric test. The anterior surface of the lens forms also a convex mirror, but it is a mirror much smaller and more convex than that formed by the anterior surface of the cornea. This image, therefore, is erect and distinct, though not so distinct nor so large as the anterior image; and, like that, it follows the motions of the candle, and is the third or deepest image of the catoptric test, Fig. 397. The posterior surface, or, more correctly, the anterior face of the posterior surface of the lens, presents, however, a concave surface, performing the part and obeying the laws of a concave mirror, which, as is well known, forms a small inverted image, that is generally seen in the focus of the mirror or at some distance anterior to its surface. This inverted image is therefore noticed between the two upright images just described; it is fainter than either of them, moves down whenever the candle is moved up, and up

PLATE XIII.

EYE INSTRUMENTS.

Fig. 1. Beer's Triangular Cataract Knife. *After Bernard and Huette.*

Fig. 2. Richter's Knife, slightly differing in the width of the blade from that of Beer.* *After Bernard and Huette.*

Fig. 3. Wenzell's Cataract Knife. " " "

Fig. 4. Beer's Lancet-shaped Knife. " " "

Fig. 5. Cheselden's Curved Corneal Knife, for incising the capsule, or enlarging the cornea in extracting cataract. Daviel's scoop or spoon is attached at the other end of the handle. *After Bernard and Huette.*

Fig. 6. Beer's Straight Knife, for enlarging the incision in the cornea in the operation of extraction of cataract. *After Bernard and Huette.*

Fig. 7. Beer's Hook, for extracting the capsule. " " "

Fig. 8. A front view of Dupuytren's Couching Needle. *After Bernard and Huette.*

Fig. 9. A side view of Dupuytren's Couching Needle. *After Bernard and Huette.*

Figs. 10, 11. A side and front view of Adams's Couching Needle. *After Bernard and Huette.*

Figs. 12, 13. A three-quarter and side view of Scarpa's Needle. *After Bernard and Huette.*

Fig. 14. A side view of Walker's Needle. " " "

Fig. 15. Benjamin Bell's Speculum. " " "

Fig. 16. Pellier's Elevator. " " "

Fig. 17. A modification of Wardrop's Forceps, for stretching the free edge of the eyelids in excising the tarsus cartilage. *After Bernard and Huette.*

Fig. 18. A Tenotome, sometimes employed in strabismus, but better adapted to larger muscles. *Kolbè's pattern.*

Figs. 19, 20. Straight and Curved Spring Scissors, for minute sections, and applicable to operations on the conjunctiva, etc. *Charriere's pattern.*

Fig. 21. Curved Forceps, for the removal of the canula, sometimes employed in fistula lachrymalis. *Charriere's pattern.*

Fig. 22. Fine blunt-pointed Forceps, for extracting the cilia in trichiasis, etc. *Charriere's pattern.*

Fig. 23. Laugier's Trocar, for perforating the os unguis, or the bony ductus ad nasum in fistula lachrymalis, when the ordinary channel cannot be dilated. *After Bernard and Huette.*

Fig. 24. Bistoury for fistula lachrymalis. *Kolbè's pattern.*

Figs. 25, 26. Bellocque's Canula, for tamponing the nostril, showing the spring as open and also as closed. *Kolbè's pattern.*

Fig. 27. Charriere's Exploring Needle. The needle, being grooved and perforated, is passed into the cavity to be examined, and then the spring being touched, the piston of the syringe is moved, and draws into the syringe, through the grooved needle, some of the liquid contents of the part into which it is thrust in the exploration. *After the instrument.*

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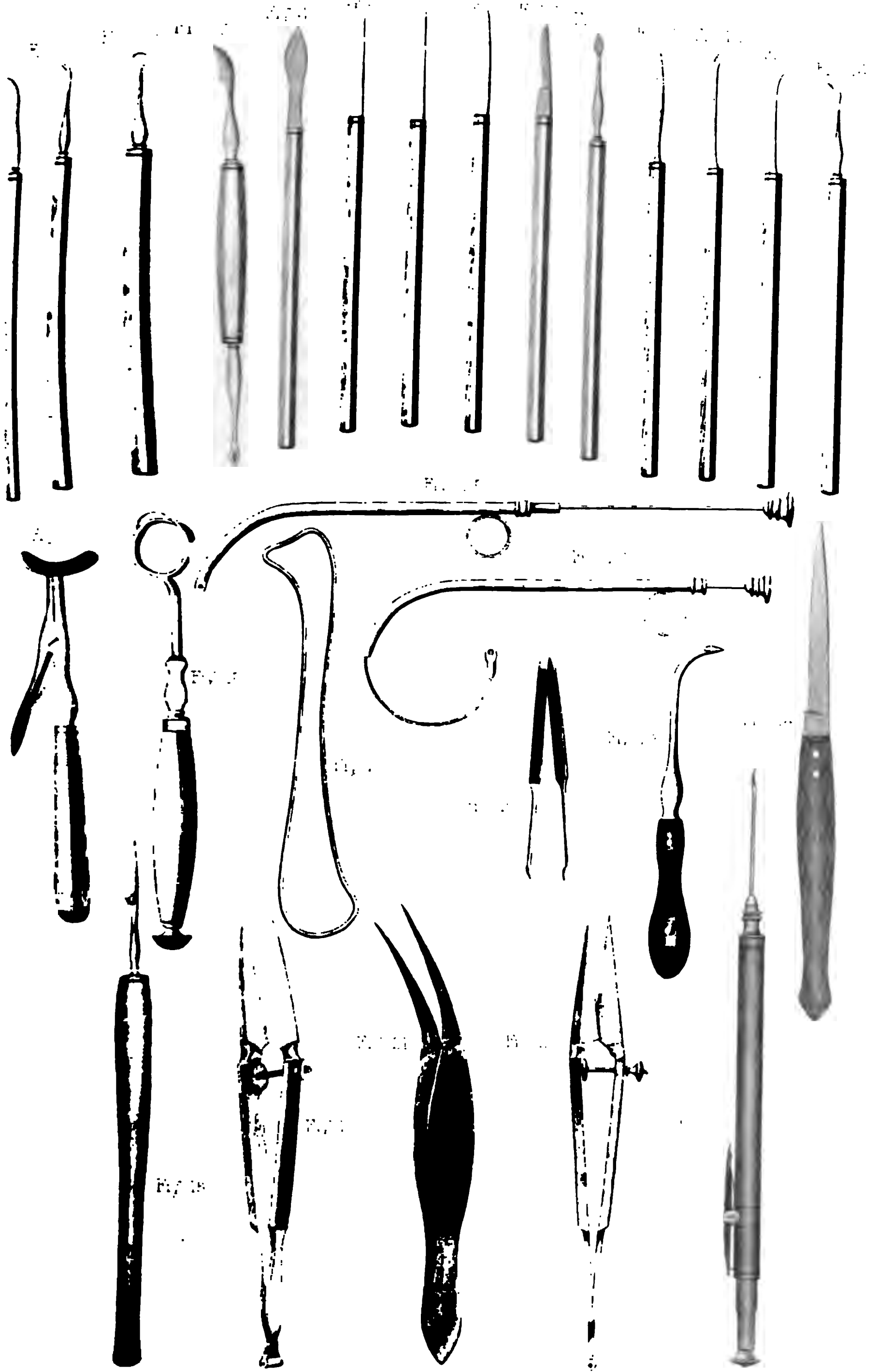
* Walton has recently shortened this knife, as stated in the text.



stances. Indeed, no rule of general treatment can here be given that will not be found to have some exception to its universal observance. Caution and judgment in this, as in other operations, can alone properly prepare the patient's constitution.

The local treatment, previous to operating for cataract, consists in the production of such a dilatation of the pupil as will enable the operator to obtain a good view of the lens, diminish the risk of wounding the iris, and admit the free access of the aqueous humor, if the operation of absorption is selected.

Dilatation of the pupil was formerly accomplished by smearing the lids, eyebrow, and temple with the extract of belladonna or stramonium, diluted with water to the consistence of thick cream, and applied every ten minutes for an hour previous to operating; or by dropping into the eye a solution of the extract; but both are objectionable as uncertain in their effects and filthy in their use. A better and more certain method is to drop a few drops of a solution of the sulphate of atropia, two grains to the ounce of water, once or twice daily into the eye, or apply cloths moistened with the solution to the closed lids a few minutes before operating. The dilatation, in most cases, is prompt, and in one instance continued for three days after the operation, leaving the iris like a fine ring near the circumference of the cornea.

The credit of suggesting the employment of narcotic agents for dilating the pupil has been long assigned, by European writers, to Himley, of Göttingen, who recommended the use of the extract of belladonna in 1801. Four years prior to this period, however, a similar suggestion had been made, and published in Philadelphia, by Samuel Cooper, a graduate of the University of Pennsylvania, who, in an inaugural essay, published in 1797, reported numerous experiments on the effects of the datura stramonium on the system generally, as well as on the pupil of the eye.* I have also been informed by Benjamin H. Coates, of Philadelphia, that Rush and Physick both taught this in their lectures, and that Physick always resorted to the formula of Cooper for its preparation.† To Cooper is, therefore, due any credit that may be connected with the suggestion.

Another step in the treatment of cataract, previous to operating, is the application of a bandage on the eye opposite to that which is to be operated on, as advised by Celsus, as it tends very materially to steady the eye if there is any vision, especially in children.

The position of the patient, of the operator, and of the assistant, together with the period at which the operation should be performed, and the kind of operation to be selected, may also be placed under the same head, and be briefly referred to at present.

The position of the patient and the surgeon depends very much upon the kind of operation to be performed. For extraction, the recumbent posture of the patient is the best, as it adds to his safety by diminishing the tendency in the humors of the eye to escape through the opening in the cornea; but, in the operations of depression or absorption, it will generally be found more convenient to place the patient on a moderately low chair, with a side light, and let the operator sit directly before him on a higher stool, or chair without arms, so as to be at perfect liberty in his movements. Some operators prefer following the advice of Scarpa, and employ a stool on which they place the foot of the same side of the operating hand, resting the elbow on the knee thus raised. Such a position is, however, purely a matter of convenience, and one which, to many, would prove exceedingly embarrassing. If the surgeon's hand requires such a support to steady it, prudence should suggest that he had better lay aside his instruments. When an anæsthetic is administered, of course the position of the patient must be the horizontal one, with the head moderately elevated.

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* A Dissertation on the Properties and effects of the Datura Stramonium, or the Common Thorn-Apple, and on its Uses in Medicine, by Samuel Cooper, M.D. 8vo. Philadelphia, 1797, p. 16, experiment 15.

† Several copies of the Dissertation may be found in the Library of the Pennsylvania Hospital, Philadelphia.

The position of the assistant should be behind the patient, with one hand placed under the patient's chin, so as to steady the head against his own breast; while the pulps of the index and second or ring finger of his other hand should be brought to the same length and to the same level, so as to raise the lid by drawing the tarsus cartilage toward the superciliary ridge, where it should be retained until the surgeon directs its release. If the eyelid is moist and difficult to hold, the assistant should dry it thoroughly, or touch the points of his fingers in a little flour or other dry powder, previous to seizing the lid. A speculum, or the elevator of Pellier, Plate XIII. Fig. 16, may be resorted to, if the orbit is deep; but, as a general rule, the eyelid may be best kept in position by the fingers placed as just described.

The period at which cataract should be operated on was once deemed a matter of importance, both as respects the season of the year, and the age, ripeness, or perfection of the opacity in the lens; but any season, with fine clear weather, will answer, while the best period, in reference to the maturation of the cataract, is that when its presence in both eyes is well ascertained. The existence of opacity being once well settled, it is best not to wait for the entire loss of vision or perfect maturation of the cataract, as every week after a well-marked opacity is evident, is liable to increase the density and toughness of the diseased structure, and, consequently, add to the difficulty and risks of the operation.

Three kinds of operations are performed for the removal of cataract, to wit: extraction, absorption, and depression, the selection of either being usually decided by the following facts:—

1st. Absorption, depression, or reclination are attended with but little risk of the loss of the eye, and may be repeated as often as is necessary; they are well adapted to soft or hard cataracts, in which the anterior chamber of the eye and the eye itself are small. Depression of a hard cataract, it should, however, be recollected, is liable to produce choroiditis or retinitis, and consequent blindness, while not unfrequently a lens, when depressed, will rise again into the axis of vision.

2d. Extraction is an operation peculiarly calculated for hard and firm cataract, but requires considerable dexterity on the part of the surgeon and his assistant, as well as a large prominent eye, with a full anterior chamber, on the part of the patient. Linear extraction is a modification of extraction specially adapted to soft cataracts. Of these operations, extraction is the more prompt and brilliant; absorption, depression, or reclination the safer. Physick and M'Clellan, in Philadelphia, and Roux, in Paris, favored extraction; but the majority of surgeons in the United States seem to prefer absorption or linear extraction. Sichel, of Paris,* "has no exclusive preference for any operation, as he depresses hard cataracts in all ages, although he prefers their extraction in aged patients. He breaks up all soft or half soft cataracts in patients below forty, and especially below thirty; but extracts them in individuals over forty, and in all those over fifty, as he finds that breaking up such cataracts in these patients is followed by swelling of the lens, which compresses the internal coats of the eye, and causes violent inflammation. In patients below forty, and especially in children from six months to fifteen years, he has found the tolerance, after the use of the needle by a skillful hand, very great."

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* Gazette des Hôpitaux, No. 54.

In order to operate upon both eyes equally well, whether the patient be placed in the sitting or recumbent posture, it becomes necessary for the surgeon to change his position, unless he is ambidexter, as he must otherwise operate upon the left eye with his right hand while in front of the patient, and on the right eye with his left hand, if in front, on account of the prominence of the nose; while, if he wishes to employ the right hand in both eyes, he will be compelled to place himself behind the patient. Having considerable facility in using the left hand, a change of position has never been necessary in my case; and as this facility can be readily acquired by daily exercise, an operator will ultimately find it more satisfactory to attempt it, and practice with the left as well as with his right hand, in order to be able always to retain his position in front of the patient, as this offers many facilities in manipulation as well as in sight.

Operations.—The operations for cataract are, as has just been stated, divided into three kinds: absorption, or that in which the lens is dissolved by the action of the aqueous humor; depression, in which it is pushed below the axis of vision, and lies buried in the vitreous humor; and extraction, in which it is promptly removed from the eye. Reclination is a modification of depression.

I. Operation by Absorption.—The success of this operation being due to the power possessed by the aqueous humor of dissolving the lens, the object of the operator should be to lacerate it and its capsule, and throw them forward into the anterior chamber of the eye. The preliminary steps in all the operations are very much the same, as respects diet and the dilatation of the pupil; it is, however, of more consequence in absorption than in extractions to obtain a full dilatation of the pupil, not only in order to admit the free action of the aqueous humor upon the lens, but also to protect the iris from injury and enable the operator to see exactly what he is doing. The needles required for cutting up the lens and its capsule are very varied, it being said that there are upwards of seventy different kinds, a few of which are shown in Plate XIII. Figs. 8, 9, 10, 11, 12, 13; they seem to have been selected very much at the fancy of each operator, though that of Saunders or of Scarpa is most frequently resorted to. All that is really essential is, that they should have a sharp double edge, and not be too long.

Isaac Hays, of Philadelphia, recommends the following knife needle:—* "This instrument, from the point to the bead near the handle, is six-tenths of an inch. Its cutting edge is nearly four-tenths of an inch. The back is straight to near the point, where it is truncated, so as to make the point stronger, but at the same time leaving it very acute; and the edge of this truncated portion of the back is made to cut. The remainder of the back is simply rounded off. The cutting edge is perfectly straight, and is made to cut up to the part where the instrument becomes round. This portion requires to be carefully constructed, so that as the instrument enters the eye it shall fill up the incision, and thus prevent the escape of the aqueous humor." "The handle should be octagonal, with equal sides and of the same thickness its whole length."

Ordinary Operation.—The capsule and lens being acted on by means of a needle introduced through the sclerotica, the operation has hence been called **scleroticonyxis.** The pupil being dilated, one eye bandaged, and the head supported against the breast of the assistant, or else the patient lying down, the surgeon should depress the lower lid with the index and second finger of the hand corresponding with the eye to be operated on, and the assistant at the same time elevate the upper lid, as directed in extraction; or, if the operator is dextrous, he may sustain both lids himself, by separating them with his thumb and forefinger. Then, seizing the handle of the needle between the thumb, fore, and second finger of the hand opposite to that of the eye to be operated on, and holding the instrument like a pen, with the fingers strongly flexed, and the little and ring finger resting against the cheek-bone, present the point of the needle perpendicularly to the sclerotica, with its convexity upward and its edges transverse, one or two lines behind the circumference of the cornea, and about half a line above or below the median line of the ball, so as to avoid the long ciliary artery. Being satisfied with its position, and while the patient is looking toward his nose, puncture the sclerotica, and rotate the handle of the instrument a quarter of a circle between the fingers; then turning the concavity of its point, if Scarpa's, or the breadth of the blade, if that of Saunders, backward, pass it toward the centre of the eye, and depress the handle toward the temple. When the point, dextrously managed, has reached the centre of the pupil, turn the cutting edge of the needle to the cataract, and cut the capsule—Plate XIV. Figs. 3, 6—and lens into several fragments, throwing them forward into the anterior chamber, where they will subsequently disappear by dissolution; or they may be removed by linear extraction, as hereafter stated.

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* Knife needle for the operation of cataract by solution or absorption, by Isaac Hays, M.D. Am. Journ. of Med. Sci., vol. xxx. N. S. p. 81, 1855.

If the cataract is soft and milky, one operation will generally suffice, but if the lens or its capsule is more resisting, it may become necessary to repeat the operation several times, at intervals of a few weeks.

After-Treatment.—The eye being closed and protected from the light, cold cloths may be applied, and the same treatment pursued as is directed in extraction. The pupil should, however, be kept dilated for several days after the operation, in order to permit the free access of the aqueous humor; and it is not requisite to enjoin such absolute rest as is directed in the operation of extraction. Should inflammation of the eye supervene, it should be treated on the general antiphlogistic plan.

When the capsule remains thickened, or when fragments do not disappear, a repetition of the operation will generally be required.

Keratonyxis, or the operation of absorption by a needle introduced through the cornea, was suggested by Conradi, but introduced into practice to a considerable extent by Saunders, and is hence sometimes designated as his operation. It consists in introducing the needle through the cornea, and lacerating the capsule in front; but, as it is liable to give exit to the aqueous humor, induce prolapse of the iris, and leave a scar in the cornea, the operation through the sclerotica is preferable in the majority of instances.

II. **Operation by Depression or Couching.**—The preliminary steps of this operation being precisely the same as those required in absorption, a repetition of them is unnecessary.

Ordinary Operation.—The position of the patient being either sitting or recumbent, and that of the surgeon being the same as in the preceding operation, the needle should be introduced into the sclerotica about two lines behind the cornea, and passed directly to the centre of the pupil between the iris and the capsule, Plate XIV. Fig. 8. Then, depressing the handle, cause the point of the instrument to apply itself on the top of the lens, and depress it backward and downward, by elevating the handle and carrying it slightly forward, Plate XIV. Fig. 7. After placing the lens in the vitreous humor below the axis of vision, retain it there a few seconds, and withdraw the needle by reverse movements through the sclerotica, with its convexity forward. The different positions of the needle during the operation are shown in Plate XIV. Fig. 4.

If the lens rises before the needle is removed, it must be again depressed, and if it escape into the anterior chamber, and cannot be drawn back, it may be removed by the section of the cornea, as in the operation for extraction.

In Reclination, the lens is turned on its axis so as to be placed horizontally instead of being depressed perpendicularly, Plate XIV. Fig. 2.

Operation of Malgaigne.—Malgaigne being of the opinion that the rising of the lens, when depressed with its capsule, was due to the attachments of the latter being rarely totally destroyed, and to the fact that its capsule resisted absorption, and was liable to rise a long time after the operation, proceeds as follows:—

The patient lying down or being seated, and the surgeon placed either before or behind him, so that he can always use his right hand, the needle is introduced—as before directed—so as to pierce the posterior and inferior part of the lens; the capsule divided, and then, the needle being passed above the lens with its concavity looking downward, a simple movement of depression suffices to cause the descent of the lens, whence it will not rise again, as the walls of its capsule collapse immediately. This proceeding Malgaigne prefers, especially when the lens is hard. Bretonneau and Velpeau lacerate freely the cells of the hyaloid membrane before depressing the lens, in order to prepare a way for its descent into the vitreous humor, and have found it often successful. About two months after either the operation of absorption or depression, the patient may very gradually commence the use of the cataract glasses, which are intended to aid vision by supplying the place of the lost lens.

III. **Extraction.**—The operation of extraction is particularly suited to the cases of hard cataract in adults with prominent eyes, and to operators who possess a perfect control of their fingers. The assistant must also be one perfectly familiar with his duty. He should place himself behind the patient, and elevate the upper lid, either with his fingers placed as before directed or by introducing Pellier's speculum beneath the lid, drawing it directly upward, making himself sure that the lid cannot escape from his grasp, and yet holding it so as to avoid pressure upon the eyeball, after the section of the cornea. On one occasion I saw an assistant evacuate the entire contents of the eye, in consequence of pressing upon the ball. Occasionally, and especially in timid patients, the surgeon may find it necessary to restrain the rolling of the eye by pressure on the ball with his fore and second or third finger, while depressing the lower lid; but it can rarely become necessary for the assistant to make any pressure upon the eye, and, as a general rule, it should be strictly avoided. Various-shaped knives have been recommended for this operation, and are known as those of Beer, Wenzel, Richter, and Ware, Plate XIII. Figs. 1, 2, 3; but most surgeons resort to the triangular knife of Beer, in preference to the others, except under peculiar circumstances. The other instrument consists in Daviel's scoop and Cheselden's knife, together with small scissors and forceps, Plate XIII. Figs. 5, 6, 7. The operation is arranged in three parts: incision of the cornea, laceration of the capsule, and extraction of the lens; although occasionally the first two are performed at the same time. The incision of the cornea may be performed either at the superior, exterior, or inferior portion of its circumference, Plate XV. Figs. 4, 3, 1. Lawrence deems the superior section the best, the exterior next, and the inferior the most objectionable, although the easiest to perform, as it exposes the patient to a rapid escape of the aqueous humor, to prolapse and wound of the iris, as well as to trouble in the adjustment of the corneal flap, from the action of the edge of the lower lid.* Sichel always extracts by

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* Lawrence, by Hays, Phila. edit. 1847, p. 640.

PLATE XIV.

OPERATION OF COUCHING CATARACT.

Fig. 1. A vertical section of the Eyeball, to show its component parts. 1. The cornea. 2. The sclerotica. 3. The choroid coat. 4. The retina. 5. The iris. 6. The anterior chamber. 7. The lens. 8. The vitreous humor. 9. The optic nerve. *After Bernard and Huette.*

Fig. 2. Reclination of the Lens, as shown in a vertical section of the eye. 1. The natural position of the lens. 2. Its reclination in the vitreous humor. *After Bernard and Huette.*

Fig. 3. The operation of absorption, or breaking up of a cataract, as practiced on the left eye. 1. The right hand of the surgeon puncturing the sclerotic coat. This puncture is usually made within two lines of the circumference of the cornea, and not as far back as is represented in the figure. 2, 2. The fingers of an assistant elevating the upper lid. 3, 3. The fingers of the left hand of the operator depressing the lower lid and steadying the ball. *After Bourgery and Jacob.*

Fig. 4. The different positions of the needle in the operation of Couching, as performed upon the left eye. 1. The needle is now held in the right hand like a pen, the hand supported by the little finger resting on the cheek-bone; the needle is also represented puncturing the sclerotica at the usual point, that is, about two lines behind the cornea, but below the transverse diameter of the eyeball. 2. The second position of the needle. 3. The elevation of the handle necessary for the entire couching of the lens, or the third position of the needle in this operation.

Fig. 5. Couching of Cataract in the right eye. 1, 1. The first and second fingers of an assistant raising the upper lid. 2, 2. The first and second fingers of the operator depressing the lower lid. 3. The cataract needle held like a pen in the left hand, the little and ring finger supported on the cheek-bone, and puncturing the sclerotica about two lines behind the cornea, and a little above the transverse diameter of the ball, so as to avoid the long ciliary artery. *After Bernard and Huette.*

Fig. 6. Position of the needle in the act of lacerating the front of the capsule in the operation of absorption, as shown in Fig. 3. *After Bernard and Huette.*

Fig. 7. Position of the needle in couching, as the lens leaves the axis of the pupil; the handle of the instrument being moved gradually upward, and the reverse, the point of the needle will carry the lens downward and backward, until imbedded in the vitreous humor. *After Bernard and Huette.*

Fig. 8. The same operation as shown in Fig. 5, after the needle has entered the posterior chamber, and partially depressed the lens. 1. The relative position of the handle of the instrument to the axis of the eye at this period. The needle, having passed between the iris and the lens, is seen, with its concavity resting on the top of the lens, previous to couching it. *After Bernard and Huette.*

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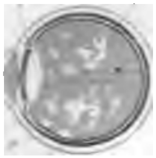
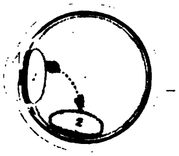
Fig. 1





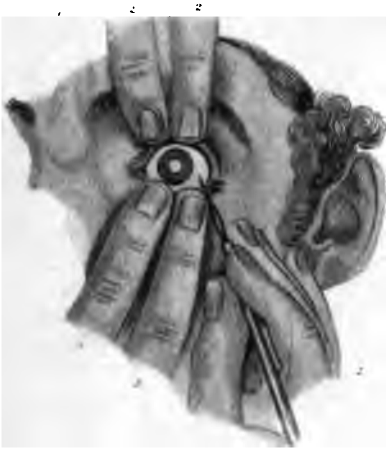
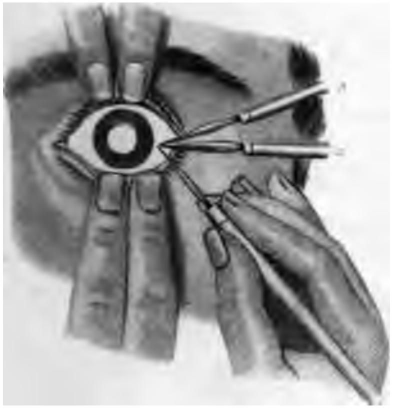


Fig. 4



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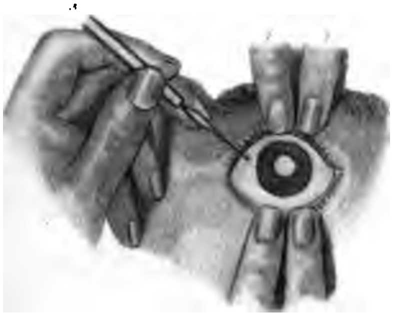


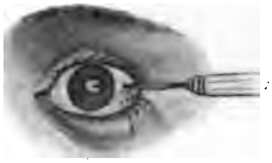
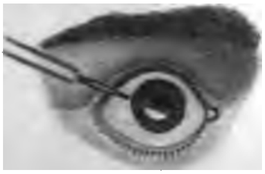
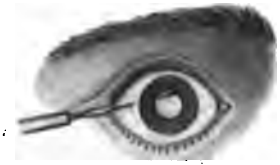


Fig. 7





the upper section, the advantages of which, he thinks, are very great, as the upper eyelid forms a kind of supporting bandage, which is still further increased by his method of applying five strips of adhesive plaster over the eyelids of each eye, and covering them by graduated compresses and a bandage in such a manner as to exert a gentle compression on the edges of the wound, and prevent its becoming separated during the movements of the patient.*

Ordinary Operation of Extraction.—The propriety of dilating the pupil previous to extracting cataract is a question not positively settled, its advocates claiming extra safety from wounds of the iris by the knife, and its opponents charging it with exposing the patient to the sudden loss of the vitreous humor. Although its dilatation certainly renders the iris more secure, yet I think a dextrous operator would probably prefer operating without dilatation, as the iris would be but little exposed to injury from a knife properly managed. The general preliminary measures being, however, completed in accordance with the views of the surgeon, the operation may be performed as follows, varying the line of the incision according as it is wished to perform the superior, exterior, or inferior section. The former, being the best, may be taken as the type.

The surgeon, either sitting or standing, and being either in front of or behind his patient, according as he is ambidexter or operates only with the right hand, should elevate the lid by the index and second finger of his left hand, separating them, and pressing their pulps against the sides of the eyeball, if it is necessary to steady it. Then holding the knife by its handle, with the thumb and fingers flexed, as in the downward motion of the pen, and resting the ring and little finger upon the cheek-bone, if desirable, to support the hand, let him insert the point of the knife perpendicularly into the cornea on its temporal side, about half a line from its circumference, or line of junction with the sclerotica, and, making sure that the point of the instrument penetrates the entire thickness of the cornea, and enters the anterior chamber of the eye, and that it has not passed between its lamina, pass it parallel to and in front of the iris, in the line of the transverse diameter of the eye, over to the internal side of the cornea, at a point corresponding with that at which it entered, Plate XV. Fig. I. If this is steadily and quickly done, the entire section of the cornea will be readily accomplished simply by the width of the knife.

The assistant should now be directed to allow the lids to close. After a few seconds' rest, they may be gently wiped and opened as before, great care being taken to avoid pressure on the ball. Then the surgeon, while elevating the lid, should press very gently against the ball from below upward, so as to render the lens prominent, or introduce the back of the little knife attached to Daviel's curette beneath the edge of the corneal flap, and press its point against the capsule of the lens and lacerate it, as is shown in the inferior section in Plate XV. Fig. 5. Generally, the lens escapes promptly, in consequence of the compression of the ball by the muscles of the eye. If it does not, moderate pressure against the ball with the handle of the curette, Plate XV. Fig. 6, or seizing the lens with the forceps, Plate XV. Fig. 8, or with the curette, will facilitate it; but in all these movements great caution must be exercised lest the vitreous humor also protrude. The operator should then see that the iris has not prolapsed or been caught between the flap and the edge of the cornea; and, being satisfied that all is right, let him at once close the eye, and cover it with a light bandage so constructed as to exclude the light, without pressing upon the ball.

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* Gazette des Hôpitaux, No. 54.

PLATE XV.

OPERATIONS FOR EXTRACTING CATARACT AND THE FORMATION OF ARTIFICIAL PUPIL.

Fig. 1. Extraction of the Cataract from the left eye by the inferior section. 1, 1. The first and second fingers of an assistant raising the upper lid. 2, 3. The middle and forefinger of the surgeon depressing the lower lid. 4. The knife held in the right hand of the surgeon; its point, having passed through the cornea and across the anterior chamber, is seen at its exit near the internal canthus. *After Bernard and Huette.*

Fig. 2. The completion of the section of the Cornea. " "

Fig. 3. Extraction by the oblique section of the Cornea. " "

Fig. 4. Extraction by the superior section of the Cornea. " "

Fig. 5. Incision of the Capsule of the Lens, in the inferior section, by the knife of Cheselden, as modified by Boyer; but the knife that incises the cornea in extraction may also be made to cut the capsule as it passes across the lens. *After Bernard and Huette.*

Fig. 6. Expulsion of the Lens in the inferior section. 1. The forefinger of the operator steadying the lower lid. 2. Gentle pressure upon the ball by the handle of the knife applied to the upper lid. *After Bernard and Huette.*

Fig. 7. Section of the Cornea by the knife of Furnari. " "

Fig. 8. The same operation, showing the removal of the cataract by forceps introduced through the opening in the cornea. *After Bernard and Huette.*

Fig. 9. Mulder's operation for Artificial Pupil. An opening in the cornea admits scissors, by which the four angles resulting from the crucial incision made in the iris are excised. *After Bernard and Huette.*

Fig. 10. Velpeau's operation for Artificial Pupil. The knife incising both the cornea and iris, so as to cut a flap in the lower portion of each. *After Bernard and Huette.*

Fig. 11. Pancoast's operation for Artificial Pupil in the first stage. 1. Finger of assistant holding up the lid. 2. The cataract knife puncturing the cornea and iris. *After Pancoast.*

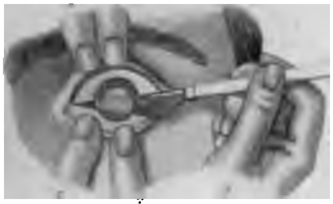
Fig. 12. Pancoast's operation for the formation of an Artificial Pupil in the second stage. 1. Finger of an assistant elevating the upper lid. 2. Probe-pointed scissors incising the iris transversely, so as to form a quadrangular pupil. *After Pancoast.*

Fig. 13. Langenbeck's operation for Artificial Pupil. A small incision is made in the cornea only large enough to admit a fine hook, by which a portion of the iris is drawn down, and left to adhere to the wound of the cornea. *After Bernard and Huette.*

Fig. 14. Scarpa's operation by displacement of the Iris. 1. A cataract needle is seen detaching the iris from the ciliary ligament, so as to leave an opening on its circumference. *After Bernard and Huette.*

Plate 15

Fig. 1



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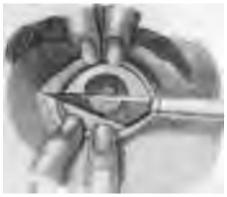
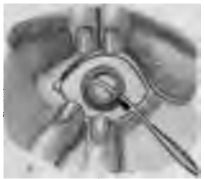


Fig. 5



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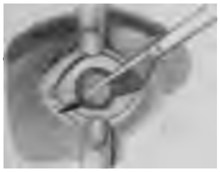

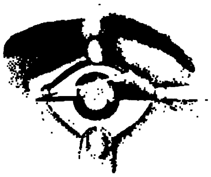

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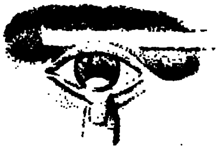
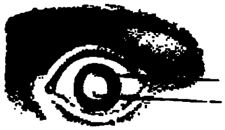
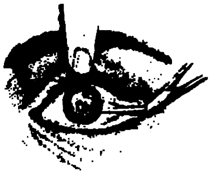


Fig. 8





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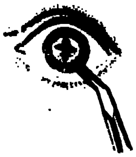
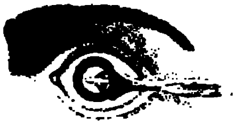
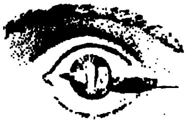


Fig. 7





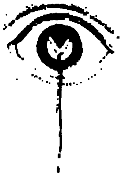
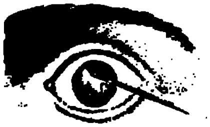
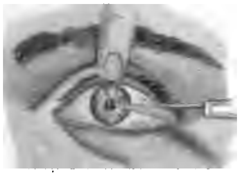


Fig. 10





After-Treatment.—The after-treatment must be regulated by circumstances, though generally it should be strictly antiphlogistic, the patient being directed to keep cold cloths applied over the lids of the affected eye, to remain quiet in a dark room, to take nothing but liquids for food, and to avoid conversation for the first three or five days. In most cases it will be found advantageous to keep the lids fastened by five little strips of adhesive plaster for a day or two, in order to prevent derangement of the wound by the motion of the lid, especially in intractable patients. The dressing employed by Sichel in the superior section also requires, as has just been stated, the addition of graduated compresses and a bandage. On the fifth day, if the lids are not red or swollen, and the patient is free from fever and pain, the eye may be gradually opened, and the condition of the parts inspected. If there is no prolapse of the iris, if the pupil is clear and regular, and if there is no very high degree of inflammation, the rigid rules before observed may then be relaxed, and the patient simply use a shade instead of the wet cloths, chew a little bread or vegetable food, and be allowed by degrees to see the light. Subsequently, but not before two months after the operation, cataract spectacles may be occasionally employed, as the patient will be compelled ultimately to use them, in order to compensate for the loss of the lens.

The performance of the inferior and exterior sections of the cornea are so similar to that just detailed as not to require a special description. They are well represented in Plate XV. Figs. 1, 2, 3.

Linear Extraction.—A valuable modification of the operation of extraction, embracing some of the steps of the operation of absorption, and specially adapted to such cataracts as can be cut into fragments, is now gaining professional favor as being less tedious than the operation of absorption, and less hazardous than that of extraction to most surgeons.

Operation.—Introduce a fine needle through the cornea, divide the capsule and lens, and throw the largest fragments into the anterior chamber. Then, with a fine cornea knife, enlarge the opening made in the cornea by the needle, and, introducing a curette or small scoop into the anterior chamber through the corneal opening, which should not surpass two lines in length, remove the fragment without disturbing the capsule.

§ 2.—Dislocation of the Lens.

It sometimes happens, as a result of blows, or other violence, that the lens is displaced, either backward into the vitreous humor, or forward into the anterior chamber, though most frequently forward. If it is thrown backward into the vitreous humor, nothing can be done but to treat any inflammation that may arise upon general principles, and, when the patient has recovered completely, supply him with a cataract glass. But if the lens is dislocated forward into the anterior chamber, it sometimes acts as a foreign body, and creates such an amount of irritation and inflammation as justifies the surgeon in making a section of the cornea and removing it, as in the ordinary operation for the extraction of cataract.

§ 3.—Formation of an Artificial Pupil.

This operation, originally suggested by Cheselden, of England, in 1728,* and performed by him on a boy fourteen years of age, was published in the

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* See Observations, etc. Cheselden's Anatomy, 13th edit. Lond. 1722.

Philosophical Transactions for that year, and also in the appendix to the fourth edition of his *Anatomy*, as well as in Ledran's *Surgery*. Cheselden furnished, however, so brief a description of his plan as to create doubts in the minds of his contemporaries as to the various steps of the operation, though it was well understood that his object was the formation of an opening in some portion of the iris, which should serve as a substitute for the natural pupil.

These doubts, and the various changes produced by disease both in the cornea and iris, together with the diversified character of the causes creating them, have led other surgeons at different periods to various modifications of his operation, although they have followed the principle laid down by him; the creation of a new point by which the light might be transmitted to the retina being the object of all of them.

These different modes of operating have been classified under five heads.

1st. Division of the iris through the sclerotica, or through an opening in the cornea, called by ophthalmologists **Coretomia**—*χορη*, the pupil, and *τομη*, a section.

2d. Excision of the iris, **Corectomia**—*χορη*, the pupil, and *εκτομη*, excision.

3d. Separation or tearing of the iris from its ciliary attachments, called **Coredialysis**—*χορη*, the pupil, and *διαλυσις*, dissolution or loosening.

4th. Separation and excision combined, or a modification of the corectomia of Wenzel.

5th. Distortion of the natural pupil. (*Hays.*)

I. Coretomia.—Operation of Cheselden.—With a very narrow and pointed knife or needle, cutting on but one edge, Cheselden punctured the sclerotica about two lines from the cornea, as in the operation of couching. Passing the needle flatwise through the posterior chamber until its point had traversed two-thirds of its transverse diameter, he cut through the iris from behind forward, by a sawing motion, and withdrew the instrument as it entered.

II. Corectomia, or Excision of the Iris.—This operation was originally performed by Wenzel in 1780.

Operation.—Introducing a cataract knife through the cornea, as in extraction, Wenzel carried its point through the iris, and made a slit in it of sufficient length to permit free vision, taking special care not to press upon the eye lest its contents should be evacuated. On withdrawing the knife, the escape of the aqueous humor caused a flap in the iris to bulge forward, and this being increased by gentle pressure with the finger on the ball, a portion of the iris was then cut off with fine scissors.

Operation of Physick, of Philadelphia.—Physick made a section of the cornea and iris by a cataract knife, in a manner similar to that performed by Wenzel, and, introducing through the opening a pair of forceps, Plate VIII. Fig. 6, terminating in small plates, one of which contained a sharp circular punch, similar to that used by saddlers, he seized the iris between the blades, and cut out a piece by closing the plates of the instrument.*

Operation of Beer.—After incising the cornea, Beer introduced a fine hook, or teethed forceps, seized the iris, drew it out, and cut off the projecting portion with the scissors.

Operation of Velpeau.—Velpeau punctured the cornea with a thin, long, double-edged knife, resembling the serpent-tongued lancet; then, passing the point through the iris, from before backward, penetrated the posterior chamber, and, passing a line or two across it, brought the knife out again into the anterior chamber, by cutting through the iris from behind forward. Passing the point again through the cornea, he cut a flap both in the iris and cornea at the same moment, Plate XV. Fig. 7, the flap in the iris retracting upon itself, and leaving a triangular artificial pupil.* This operation is also but a modification of that of Wenzel.

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* Dorsey's Surgery, p. 347. Philadelphia, 1823.

Mulder, after incising the cornea, introduced fine scissors, and cut out the four angles of a crucial opening made through the iris, Plate XV. Fig. 9.

Operation of Pancoast, of Philadelphia.†—Pancoast, having slightly modified the operation of Maunoir, forms the artificial pupil as follows: The patient being seated in a good light, an assistant raises the upper lid while the surgeon depresses the lower and enters the point of Wenzel's cataract knife into the cornea at the usual place for extraction. As soon as the point is seen in the anterior chamber, the handle is brought forward and the point directed obliquely backward upon the iris, so as to pierce it at about half a line from its ciliary margin, where the lens is most distant from it, and least liable to injury. As soon as this puncture is made, the handle is carried backward, so as to bring the iris forward on the point of the knife, which is then carried on so as to divide both the iris and cornea, until the point of the instrument has advanced half way between the place of puncture of the iris and the closed pupil, Plate XV. Fig. 11, when the instrument is to be carefully withdrawn, the escape of the aqueous humor being very slight when this is well done. The incision of the cornea should be about one-fifth of its circumference, and that of the iris should have a shape concentric with its outer margin.

The delicate probe-pointed scissors of Maunoir being then inserted, closed and flatwise, through the corneal opening, should be slightly opened, and the handles turned so as to look obliquely downward and forward, so that the blade next the cornea may not injure it. Then, one blade being carried through the puncture of the iris, behind that membrane, and the other in front, as far as the centre of the old pupil, Plate XV. Fig. 14, the handles are to be brought directly horizontal, and the second incision made by closing them. Not a drop of blood will escape, and an artificial pupil will be at once formed, which will be widest at its centre. The subsequent use of belladonna for a few days assists in keeping the new pupil dilated as widely as possible.

III. Coredialysis, or Laceration of the Iris.—This operation, as suggested by Scarpa, was performed by him, in 1801, as follows:—

Operation of Scarpa.—"The patient being seated and held as in the operation for cataract, the sclerotic coat is to be punctured with a needle (Scarpa's) about two lines from the union of the sclerotica with the cornea, and the point of the needle made to advance as far as the upper and internal part of the margin of the iris, that is, on the side next the nose The instrument should then be made to pierce the upper part of the internal margin of the iris close to the ciliary ligament, until its point is just perceptible in the anterior chamber of the aqueous humor; I say just perceptible, because that part of the anterior chamber being very narrow, if the point of the needle is made to advance ever so little before the iris, it must pass into the substance of the cornea. As soon as the point of the needle can be seen in the anterior chamber, it should be pressed upon the iris from above downward, and from the internal toward the external angle, as if with the view of carrying the instrument in a line parallel to the anterior face of the iris, in order that a portion of its margin may be separated from the ciliary ligament. This separation being obtained, the point of the needle should then be depressed in order to place it upon the inferior angle of the commenced fissure, which may be prolonged at pleasure by drawing the iris toward the temple, and carrying the instrument from before backward, in a line parallel to the anterior surface of the iris, and the greater axis of the eye,"* Plate XV. Fig. 14.

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* Bernard and Huette, p. 153

† Operative Surgery, 3d edit., p. 218.

Operation of Langenbeck.—This surgeon opened the cornea by a small knife or needle, and then, passing a fine hook through the wound, with its convexity presenting upward, carried it through the anterior chamber with the hook presenting flatwise between the cornea and the iris to the very margin of the latter. Then, turning its point against the iris, he transfixed it by gentle pressure, drew the hook and the iris very carefully through the wound, drawing upon the iris until the new pupil was sufficiently large, and, finding that the iris when not drawn upon would remain in the wound, he withdrew the hook and left the iris to contract adhesions in the opening of the cornea, Plate XV. Fig. 13. It is essential to the success of this operation that the opening in the cornea should not be larger than is requisite for the introduction of the hook, otherwise it will be difficult to retain the prolapsed portion of the iris in the wound.

IV. **Distortion of the Natural Pupil.**—Hays, of Philadelphia, in 1840 formed an artificial pupil by the following operation:—

Operation.—The patient lying down, the lower lid of the right eye was depressed by an assistant, and the upper lid held by the operator with the two forefingers so as to steady the ball with the third finger Then a section of the cornea, commencing near its junction with the sclerotica, a little below its middle, and extending so as to divide one-fourth of the circumference, was made by a cataract knife being carried steadily and quickly forward so as to prevent the escape of the aqueous humor, and prevent prolapse of the iris before the incision was completed. As soon as the knife was withdrawn, the humor escaped with a gush, and the lids were allowed to close, and, on separating them after the lapse of a minute or two, the iris was found prolapsed so as to draw the lower edge of the pupil quite to the incision. The patient subsequently enjoyed excellent vision.†

After-Treatment.—After any operation for artificial pupil, it is of great consequence that the antiphlogistic treatment, with the use of belladonna or atropine, should be rigidly observed, the strictest attention being given to the prevention of vascular excitement, by diet, venesection, purging, and cold applications outside of the lids.

Remarks on the Value of these Operations.—From the variety of circumstances requiring the formation of an artificial pupil, it is impossible for a surgeon to select any one method of operating as preferable to the others, and his choice must, therefore, be decided by the peculiarity of the case. The position of the pupil must also be governed by the opacity of the cornea; but, as a general rule, the most eligible place for it is as near as possible to the centre of the old one. When it becomes necessary to form a pupil near the circumference of the iris, the nasal is by some deemed preferable to the temporal side, in consequence of its affording more probability of a correspondence with the optic axis of the other eye. Gibson, of England, with others of extensive experience, object to this, and deem the opening on the temporal side preferable to any other, as permitting a wider field of vision;* but here, as in the other questions connected with the operation, the decision must be regulated by the circumstances of the case. The inferior and external portions are less eligible, and the superior is objectionable from being more covered by the eyelids. As illustrative of the peculiar advantages of one mode of operating over the other, the following conditions of the eye may be referred to:—

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* Observations on the Principal Diseases of the Eye, by Antonio Scarpa. Translated from the Italian by James Briggs, Surgeon. Lond. 1806, p. 412

† Lawrence on the Eye, edited by Hays. Philadelphia, p. 456.

1st. When the opacity is in the centre of the cornea of one eye, the lens being round, and the iris not prominent anteriorly, and when the other eye is sound, coretomia, or incision of the iris, will be best suited to the case.

2d. Coredialysis, or displacement, is specially adapted to cases of opacity of the cornea involving a greater portion of its convexity, but where the circumference is clear.

3d. When the capsule of the lens is affected, or the iris is adherent anteriorly or posteriorly, the other operations mentioned may be resorted to.

The extent and importance of the subject will, however, forbid any special recommendation of any operation; and in this, as indeed in most of the affections of the eye, the reader will find it advantageous to consult the works of those who have devoted themselves specially to ophthalmic surgery.

§ 4.—Insertion of Artificial Eyes.

When from any cause the ball of the eye has been partially or even entirely evacuated of its humors, and nothing is left but a bulb or stump to which the muscles are attached, or when the cornea has been rendered so opaque that vision is impossible and the eye a deformity, it is often desirable to conceal it by artificial means. In the perfectly opaque cornea, the humors of the eye should be partly evacuated by puncture, and then, when the wound has healed, an artificial eye may be employed with great advantage to personal appearance, the artificial eye being moved by the motion that remains in the eyeball. So perfectly is this the case, that an unprofessional observer will often be unable to tell a glass eye from a natural one. Artificial or glass eyes are polished enamel disks, colored like the natural eye, and made both in Europe and the United States, those of domestic manufacture being now so perfect as to compare favorably with the best that are imported. They may be obtained through any druggist or optician at moderate prices, costing about six dollars each, if bought in quantities.

Introduction.—After selecting an eye of the color, convexity, clearness of sclerotica, and size of pupil most like the remaining eye of the patient, seize it between the thumb and forefinger of the right hand and dip it into a glass of tepid water. Then with the left forefinger and thumb elevate the upper lid, and, sliding the artificial eye under the edge of the lid, push it gently back into the orbit and let the lid close on it. On depressing the lower lid by the left middle finger, slip the false eye within it, the subsequent action of the lids holding it in its place against the ball, and giving it the proper central position in the orbit.

In order to remove it, take a probe or bodkin, and, depressing the lower lid, slip the probe between the lid and the ball and slightly under the edge of the glass eye; then using it gently as a lever, catch the artificial eye as it escapes from the lids on the palm of the hand, or in a handkerchief held to receive it.

After its removal, let it be thoroughly washed in tepid water, dried, and put away in soft cotton—especially in cold weather—to preserve an equal

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* Littell on the Eye, p. 267.

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ER IV.

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PLATE XVI.

METOPLASTY AND RHINOPLASTY, OR PLASTIC OPERATIONS ON THE FOREHEAD AND NOSE.

Fig. 1. A front view of the Face of a patient, forty-two years of age, who had a large ulcer in the forehead, accompanied with syphilitic caries of the frontal bone, previously to being operated on by Watson, of the New York City Hospital. The ulcer is represented with thickened and inverted edges, and as retaining a portion of the necrosed bone; a fistulous orifice is also seen at the upper border of each orbit, with another in the left temple, through which pus escaped freely. The eyebrows and upper eyelids are shown as slightly elevated and deformed by the adventitious adhesions existing around these fistulæ. The bone in the centre of the ulcer presents the ordinary characters of caries and necrosis. *Copied from a likeness taken by Watson.*

Fig. 2. Represents the condition of the patient near the termination of the treatment. A linear cicatrix is seen on the forehead, with one or two larger points or depressions in the skin caused by its adhesion to the surface of the bone. *After Watson.*

Fig. 3. Represents the line of incision, together with the sutures and lines of union in the wound immediately after the operation. *After Watson.*

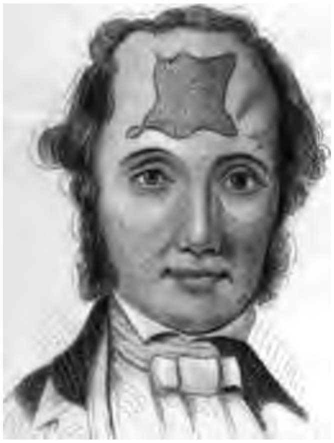
Fig. 4. Rhinoplasty, as practiced according to the Indian method, by Delpech. A triangular, or somewhat V-shaped flap, 1, 2, 3, has been cut upon the forehead, so that the point of the V will correspond with the root of the nose. At 2 an additional portion has been excised with the flap in order to form the column of the nose, and at 4 the flap is seen rotated upon its base, so as to be brought down in front of the nasal cavity. To favor this rotation, and prevent the constriction of the vessels in the flap which would otherwise result, the incision at the base of the flap has been made slightly longer on the right than on the left side of the nose. The numerous sutures requisite for the approximation of the flap to the nose, together with the bougies introduced into the nostril for the support of the alæ, and to preserve the orifices of the nostril, are also represented. *After Bernard and Huette.*

Fig. 5. A side view of the original Taliacotian operation, or that revived by Græfe, with the bandage or jacket worn to support the arm until adhesion occurs in the base of the flap. 1, 2, 3. The flap, cut from the skin of the arm, and attached over the nasal cavity by numerous sutures.

After Bernard and Huette.

Plate 16.

Fig. 1.



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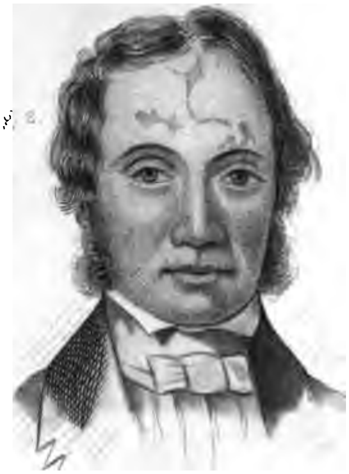

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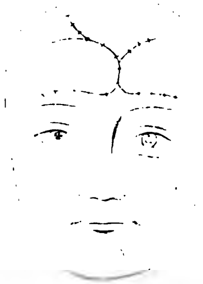


Fig. 4.

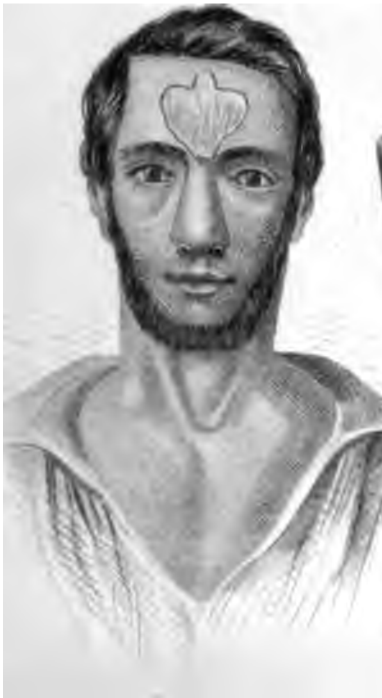
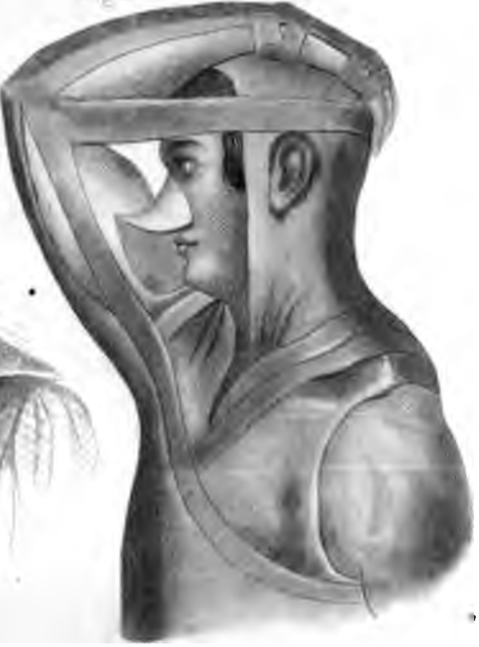


Fig. 5.



trized, with the exception of a papillary opening communicating with a small point of carious bone that had been overlooked in the operation, and had not then exfoliated. Plate XVI. Fig. 2 represents the patient when cured.

SECTION II.

ANATOMY OF THE EXTERNAL NOSE.

The general relations of the nose to the surrounding parts are so well known that reference to them in detail is deemed unnecessary. The structure of the nose, proceeding from the outside to the cavity of the nostril, is composed of the skin, cartilages, bones, and mucous membrane.

The skin on the upper portion, or root of the nose, is similar to that on the forehead, is loosely attached to the subjacent parts by a free areolar tissue, and is, therefore, very movable. At the point and lower half of the nose, or sides of the nostril, it is abundantly furnished with sebaceous follicles, and is attached to the cartilages by short fibrous filaments which render it very immovable and difficult to dissect from the subjacent parts, without injuring them. These follicles are generally the seat of the lipomatous tumors found in this region. When they attain such a size as to demand extirpation, it may be accomplished in the manner and with the precautions hereafter stated. The wound may be subsequently closed by sutures and adhesive strips, or, if very extensive, as is sometimes the case, be left to heal by granulation and cicatrization. The skin of the alæ of the nose is sometimes the seat of a rapidly spreading ulceration, designated by dermatologists as *Lupus*. Its consideration belongs properly to a treatise on the diseases of the skin.

The cartilaginous portion of the nose is formed by a vertical cartilage or septum, placed in the middle line of the nose, continuously with the bony septum formed by the vomer and nasal lamella of the ethmoid bone, and of the oval cartilages or oblong oval plates, which, forming the structure at the point, are directed upward and backward from the cartilaginous septum. The contact of the oval cartilages with each other forms the columna nasi.

The alæ nasi, or convexities on the sides of the nostrils, owe their shape to several small cartilages, united by ligamentous matter. They keep the nostril patulous, and also permit its free motion.

The mucous membrane covers these cartilages as well as the bones of the internal nose.

SECTION III.

OPERATIONS UPON THE EXTERNAL NOSE.

The operations practiced upon the **external portion of the nose** may be demanded either for the removal of lipomatous tumors; for occlusion of the nostril as the result of ulceration or burns, or for the cure of deformities arising from loss of substance.

The class of tumors usually known as **Lipomatous**, and described as such, or as carcinomatous, are occasionally seen on the lower extremity of the nose. These tumors have been very indefinitely described by European writers, who have sometimes merely referred to them as "an increase in the thickness of the skin, which sometimes becomes a prominent swelling,"* or as "a hypertrophied condition of the integuments and subcutaneous adipose tissue."* The soundest view of their pathology will, therefore, it is thought, be found in a paper on Polypi and other Tumors of the Nose, by Watson, of New York, who regards them as neither carcinomatous nor lipomatous, but as dependent on a hypertrophy of the integuments and connective tissue, attended with sero-fibrinous infiltration and with excessive development of the sebaceous cryptæ proper to the integuments. He also regards them as mainly dependent on enlargement of the sebaceous crypts of the nose, being in fact analogous to the polypous growth. They are slowly developed, unattended by pain, and occur either singly or in groups, being disposed to assume a pyriform shape, to become pendulous and to grow to an enormous size, reaching, in some instances, to the lower lip, and in others below the base of the chin.† Their appearance is often a strictly local complaint, as they are limited to the skin, do not involve the nasal cartilages, and, though vascular, and disposed to bleed freely, may be removed by shaving or dissecting them off from the cartilages, care being previously taken to introduce a finger into the nostril so as to prevent the injury of the alæ by the incisions, the ulcer, when large, being allowed to heal by the second intention.

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* **Ferguson,** *p. 426, 2d edit. Philada.* **1853.**

The relief of the contraction of the nostrils resulting from lupus, scrofulous ulcers, or burns requires the formation of an opening by paring away the tissue around the nasal orifice, and an endeavor to heal the ulcer by the use of nitrate of silver. The production of the opening is sufficiently easy, but its preservation, even with a free excision of the surface of the alæ, is frequently very difficult, cicatrization and subsequent contraction often closing it as soon as the tubes or sponge-tents are removed.

In a young lady, in whom both nostrils were completely closed, as the result of scrofulous ulceration, the mucous membrane was perfectly sound, and its secretion free enough to escape by the posterior nares; yet, notwithstanding free excision, the use of tents, caustic, etc., I failed to effect a permanent restoration of the passage.

§ 1.—Rhinoplasty.

The ancient punishments of cutting off the nose, as well as the marked deformity caused by its loss as the result of sloughing, induced surgeons at a very early period to devise some mode of correcting the deformity. Plastic surgery, indeed, appears to have originated mainly in the desire to conceal the loss of so prominent a portion of the face, and much ingenuity has been shown in devising flaps, obtaining grafts from other parts, etc., in connection with this special class of operations.

The restoration of the whole or of a part of the nose constitutes a variety of the class of plastic operations designated as **Rhinoplasty.** These operations are among the most tedious and painful in surgery, and, before undertaking them, the surgeon will find it advantageous to resort to the following preliminary measures: 1st, make the patient fully aware of what it is necessary to suffer; 2d, inform him of the chances of failure from want of vitality in the new portion; 3d, of the great tendency to contraction in the new organ; 4th, of the probable difference in color and texture between it and the nose in its natural condition. When the result is fully understood by the patient, the surgeon should proceed to study most thoroughly the probable shape and natural characters of the lost part; make ample calculation for the shrinking of the flap, allowing, generally, for the ultimate loss of at least two-

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[*] Miller's Practice, p. 162, 3d edit. Philada. 1853.

[†] Am. Journ. of Med. Sciences, April, 1842, p. 345

thirds of the portion at first taken; and, cutting pieces of thick, or moderately stiff paper, or, what is better, kid or soft leather, fit them to the part, or mould a wax nose upon the deficient portion, and, by flattening it, endeavor to obtain an accurate pattern of the shape of the integuments that will be required, marking it upon the skin that is to furnish the new structure by means of lunar caustic. In addition to this, let him also prepare his patient most carefully by an appropriate general treatment, and select such a period and locality as will be most likely to ward off an attack of erysipelas. In operating for the restoration of a nose where the bones and cartilages are all destroyed, he should also make his patient comprehend that, as the bridge has been destroyed, the new nose will never present the convexity of the old one, but that, though thus defective, it may yet look better, and render him more comfortable than he was before the operation.

The various modes of performing plastic operations have been arranged under three classes: 1st, the Indian method, or original plan of the Brahmins, in which the flap is taken from the integuments of the forehead; 2d, the Italian or Taliacotian operation, where the flap is taken from an extremity, usually the arm, near the insertion of the deltoid muscle, several days before it is applied to the deficient portion; 3d, where it is taken from the forearm, with some modifications, as practiced by Græfe and others among the Germans; and 4th, the French plan, in which a piece taken from the neighboring parts is slid over or rotated so as to cover the deficient portion.

To these may be added the insertion of a piece directly removed from some other portion of the body, and attached to the deficient part.

Plastic surgery, as illustrated by the plastic operations performed on the Face, dates from a very early period, having been long practiced in India in order to remedy the losses occasioned by the punishment of criminals, whence the origin of the Brahmin method of operating. In 1597, Taliacotius, of Venice, whose attention had been largely devoted to the relief of these deformities, operated by taking a flap from a distant part, and applying it to the part which was to be restored, subsequently freeing it from its stem, when it had united. Having published a volume on the subject, in which he detailed his methods of operating, the term Taliacotian has since been often employed to designate all plastic operations, though it should be strictly limited to his or Branca's peculiar plans. Græfe, of Germany, modified this method in 1815, resorting to immediate union of the flap; while Labat, Serre, and others, in France, in 1834, published long accounts of their success by means of flaps taken from adjoining parts. In the United States, the Taliacotian operation had nearly fallen into oblivion, when it was successfully revived, in 1837, by Mason Warren, of Boston, who modified the operation of Græfe by taking the flap directly from the forearm instead of the arm. Since then, rhinoplasty in different forms has been frequently resorted to with varying success, by Pancoast and Mütter, of Philadelphia; and the original Taliacotian operation for restoration of the end of the nose has been frequently performed by Horner and other surgeons. In nine cases operated on by Pancoast, and combined with the "plastic suture," the parts uniformly united by the first intention.

As the Brahmin method is preferable to that of Taliacotius, when the forehead is capable of furnishing the flap, I mention it first.

§ 2.—Indian or Brahmin Method of Rhinoplasty.

Operation of Mason Warren, of Boston.—The patient, a young man, aged 28 years, had lost, from ulceration, the whole nose, cartilages, septum, and bones. In the place of the nose there existed an opening, about one inch in diameter, bordered by a firm cicatrix; and, the septum being destroyed, the cavities of the two nostrils were thrown into one. The four front teeth, with the alveolar processes, had also been lost, and there was an opening between the lip and the upper jaw through which a probe might be passed from the mouth into the nasal cavity. The favorable circumstances connected with the case were the healthy state of the integuments surrounding the opening of the nasal fossa, the great height of the forehead, the whiteness and delicacy of the skin, and the good state of the patient's health.

Operation, Sept. 7th, 1837.—A piece of pasteboard, cut in the shape of the letter V, that is, triangular, and with a projection from its base corresponding with the columna of the nose, was placed upon the forehead, and a trace made around it with the nitrate of silver, as recommended by Lisfranc, in order that it might not be effaced by the blood. A trace was also made around the opening of the nasal fossa, at the points where it would be necessary to remove the integuments for planting the new skin taken from the forehead. This was done the night previous to the operation. The clothing being arranged, the patient was laid on a table with his face toward the window and the operator behind him, so as to have the full command of the head. The traces made by the nitrate of silver were about two-thirds of an inch apart between the eyebrows; each side of the triangular portion of the skin was three inches and a quarter in length, with a base of three and a half inches, and the projection from the columna of the nose, which was to be taken entirely from the scalp, previously shaved, was an inch and a half long, and two-thirds of an inch wide.

"The head being firmly supported by two assistants, the incision was commenced between the eyebrows and the flap of the skin dissected up so as to isolate it entirely from the skin of the forehead, except where, for the purpose of nutrition, it was left adherent at the root of the nose. The incision on the left side, between the eyebrows, was extended a little further down than on the right, the better to facilitate the twisting of the flap. This incision included the skin, subcutaneous cellular tissue, and a portion of the occipito-frontalis muscle, care being taken not to raise the periosteum from fear of necrosis. The flap, thus dissected and twisted round to the left side, was carefully wrapped in a compress of linen cloth, and before the operation was proceeded in further, attention was given to diminishing the large wound made in the scalp (forehead)—Plate XVI. Fig. 4—little hemorrhage had taken place, and the temporal arteries which had been cut very soon retracted and ceased bleeding. The angles of the wound were now brought together by the twisted suture, two pins being employed on either side. Its edges between the eyebrows were also approximated in a similar manner, and by this means the wound in the forehead was at once diminished to less than half its original size; it was still further reduced by the use of a few strips of adhesive plaster; and a little scraped lint filled up the remainder of the wound. Some spread cerate was placed over the whole surface with a pledget, and the dressing was secured by a bandage round the head.

"The next object was to fasten the borrowed skin in its place. In order to do this, it was necessary to freshen the borders of the opening in the nasal fossa, the traces of which, as stated, had been previously made with the nitrate of silver. For this purpose, a short, narrow knife, somewhat similar to a cataract knife, was used, (resembling the original knife of Taliacotius,) and a strip of integument a third of an inch broad, including all that had been indurated in the old cicatrix, removed. The knife was also passed between the lip and upper jaw, in which existed, as before stated, an opening large enough to pass a probe, and the adhesions between the two for the space of an inch entirely cut away, for the double purpose of giving the columna of the nose a more deep and firm adhesion, as well as to close up by inflammation the unnatural communication between the mouth and nasal cavity.

"The flap was now brought down into its place, its angles a little rounded with the scissors, the better to simulate the alæ of the nose, and the whole secured in its place by pins and points of the interrupted suture." In a subsequent operation, the interrupted suture was used, and is generally preferable.

"From that portion of the skin which was to form the columna, the epidermic side was pared a little, so that it might form an adhesion, not only underneath to the jaw, but on its sides to the quadrangular wound made for it in the upper lip.

"A little scraped lint was now placed under the ends of the pins, and a strip of oiled lint introduced into each nostril to prevent adhesion; another strip was placed upon the nose to preserve its temperature, and the dressings were confined by a band of adhesive plaster fixed to the forehead above and partially divided in the middle, so that it might descend on each side of the nose to the lip."*

A double T-bandage, made of narrow tape, the horizontal portion of which is applied to the upper lip, and the two vertical portions carried over the root of the nose, will also serve a good purpose and be free from the objections to the use of adhesive plaster.†

Operation of Pancoast, of Philadelphia.‡—After marking out the flap, as described in the preceding operation, cut out a second model in adhesive plaster and fit into the space just marked out on the forehead by placing its apex perpendicularly between the eyebrows; or, if the forehead is low, to place it in an oblique instead of a vertical direction, so as to avoid cutting into the hairy portion of the scalp. After thus delineating the flap on the forehead, the points for the sutures and their corresponding places on the sides of the nasal opening should be denoted with ink or colored varnish, Plate XVII. Fig. 4, in order to insure the accurate adjustment of the flap to the nose. The peduncle of the flap at the root of the nose should also be calculated so as to leave it from a half to five-eighths of an inch wide, in order to permit the rotation, and also preserve the nourishment of the flap by one or both of the angular arteries of the nose.

The first step, now, consists in so freshening the edges of the stump of the nose that it may leave a groove for the reception of the flap, the nostrils having been previously filled by lint so as to prevent the blood flowing back into the throat.

The second is the dissection of the flap from the forehead and the closing of the wound—made by its removal—with twisted sutures, compress, etc.

In a third step, the flap is brought down to its place and retained there by the following suture, to which the operator attributes much of the happy results that have attended his nine operations, all of which united by the first intention. This suture he forms in the following manner:—

The Plastic Suture.—Three waxed silken ligatures, armed with a needle at each end, are to be placed in the groove at each side of the nostril, by passing one needle from without inward through the inner wall of the groove, and then from within outward, at a point about one-eighth of an inch above its first puncture, in such a way as to leave this needle and that attached to

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* Boston Med. and Surg. Journ., vol. xvi. p. 69, 1837.

† See vol. i. p. 131.

‡ Operative Surgery, 3d edit. p. 350, *et supra*, 1852.

PLATE XVII.

RHINOPLASTIC AND CHEILOPLASTIC OPERATIONS.

Fig. 1. Appearance of John Glover prior to the operations of Cheiloplasty and Rhinoplasty. *After Pancoast.*

Fig. 2. View of his face with the chin depressed. The mouth, being contracted into a rigid orifice, was enlarged laterally by the stomato-plastic operation of Dieffenbach for atresia oris, after which two flaps were made, as marked in the lines upon the cheeks, so as to form the upper lip. *After Pancoast.*

Fig. 3. Appearance of his face after this operation, showing the position of the sutures and the improvement in the mouth. *After Pancoast.*

Fig. 4. Shows the steps of the Rhinoplastic operation performed upon him subsequently. The edges of the nasal cavity being freshened by a gooved incision, the outline of the new nose was marked on the forehead before cutting the flap. The dots indicate the position of the sutures. *After Pancoast.*

Fig. 5. The wound in the forehead being closed by the hare-lip sutures, the flap was reverted, and attached in the groove on the edge of the nasal cavity by three stitches of the interrupted suture, which were tied over little rolls of adhesive plaster, after Græfe's method. The edge of the septum is also attached to the upper lip. The twist in the pedicle is seen in the root of the nose.

After Pancoast.

Fig. 6. An accurate likeness of John Glover, sixteen months after the operation. *After Pancoast.*

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Fig. 1

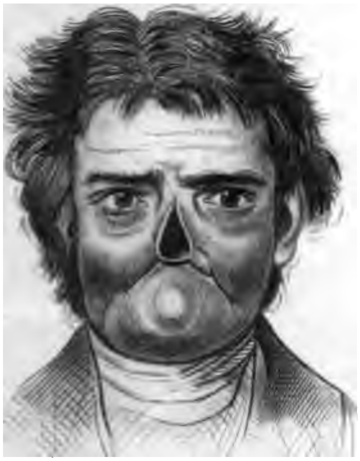


Fig. 2

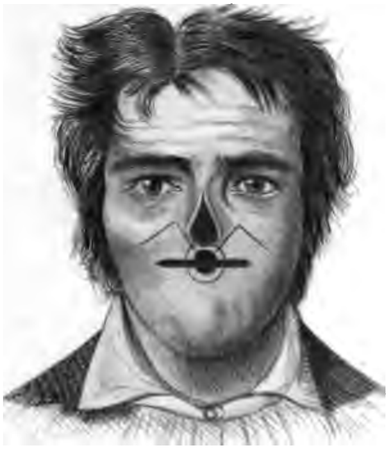


Fig. 3

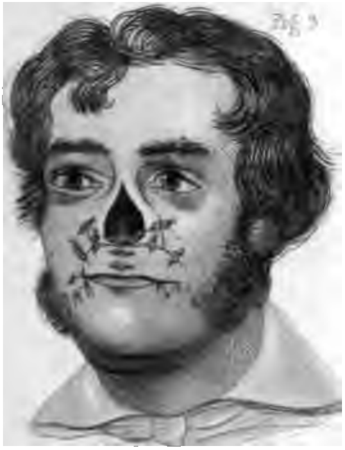


Fig. 4

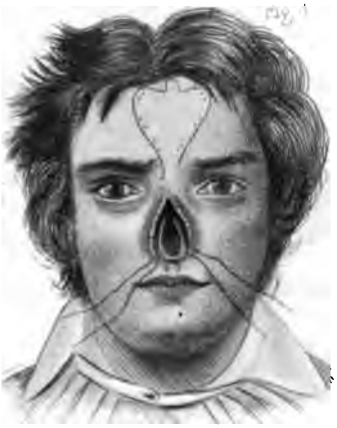


Fig. 5

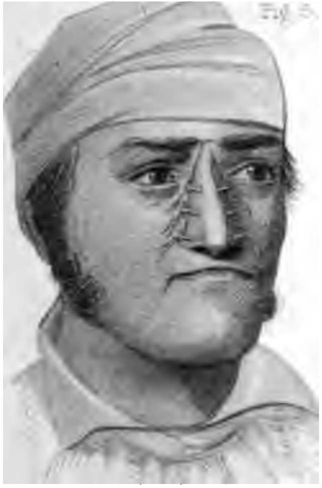
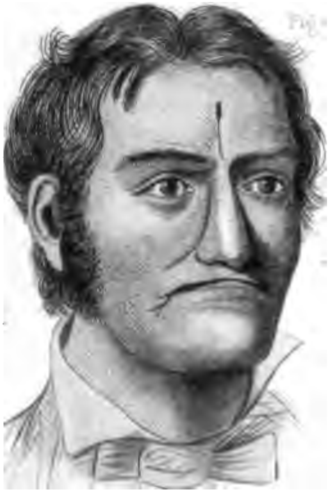


Fig. 6



the opposite end of the same ligature resting on the cheek, the loop on the inner side of the groove being thus made to embrace about one-eighth of an inch of its inner surface, Plate XVII. Fig. 4. Then, when the edge of the flap is adjusted to the groove, the two needles are to be passed through the margin of the flap from within outward, so that, when drawn tight, the ligature will necessarily sink the edge of the flap to the bottom of the groove, and bring the upper and under surface of the edge of the flap in contact with the outer and inner edge of the groove, and thus facilitate the union ; after which the ligatures are all to be tied over small rolls of adhesive plaster, after the manner of Græfe and Labat, so as not to strangulate the parts included in the loop, Plate XVII. Fig. 5. After applying greased lint internally and externally, the warm water-dressing was continued on the nose, and the pedicle near the forehead not divided for five or eight weeks.

Remarks.—In the performance of these operations, great attention should be given to the following points :—

1st. To mould a good nose—in soft wax—to the nasal cavity, and then flatten it out, in order that it may serve as a model for the flap.

2d. To obtain a sufficiently large and full flap from the forehead, of the shape, but not the size of the model, as it is almost imposible to anticipate the amount of the subsequent contraction of the new covering of the nose.

3d. To dissect up all the integuments of the forehead above the periosteum, the latter being left untouched.

4th. To make a good groove on the sides of the nostril, and bevel the edges of the flap, so as to fit it accurately.

5th. To unite the edge of the flap to the sides of the groove by the *plastic suture*.

6th. To unite the column of the new nose to the gum, and to bevel its edges so as to prevent their union with the margins of the flap which form the alæ of the nostril.

7th. To guard against contraction of the orifices of the nostrils, or their union with the septum, either by the use of rolls of greased linen, by the introduction of a piece of catheter, or by beveling off the edge of the alæ, and turning it into the nostril so as to form a sort of hem to the edge of the orifices, as suggested by Labat.

8th. If the nasal orifices contract, then to pare them off and treat the surface with nitrate of silver until healed, taking care to distend the opening during the process.

The greatest care in nursing is also essential, especially for the first few days, lest the patient should, by any inconsiderate movement, disturb the flap before union has occurred.

Cheiloplasty and Rhinoplasty.—A man, aged fifty-three, had lost all the soft parts of the nose and whole of the upper lip, from the commissures of the mouth to the canine fossa of each side, as well as the septum narium and the turbinated bones, the cavities of the antrum Highmorianum and of the sphenoidal sinuses being exposed. His appearance, with his mouth closed, is shown in Plate XVII. Fig. 1. The mouth, when opened, presented a rigid circular orifice three-fourths of an inch in diameter.

Operation of Pancoast.—The mouth being widened after Dieffenbach's method, Plate XX. Fig. 7, the free surface of the gum was freshened, and an incision was then made obliquely upward and outward for a quarter of an inch from the point where the gum was covered by integuments, and from the end of this another cut was made for about the same distance, nearly parallel with the incisions for widening the mouth, but inclined a little downward. The cheeks being now loosened from the gum and malar bone by incisions on the side of the mouth, the flap of skin and subcutaneous fatty matter was raised from the surface of the muscle by beginning the dissection at the angle next the nose, Plate XVII. Fig. 2.

The arterial branches, which were divided, having been twisted, the flaps were drawn downward and forward over the raw surface of the gum and fastened together with the hare-lip suture, Plate XVII. Fig. 3, the inner edge of the rotated flaps being thus united in the middle line of the lip. The face being then dressed with lint wet with lead-water and laudanum, the patient recovered in about two months. The nose was subsequently formed as follows:—

The hair being shaved from the temple and forehead, the nasal orifices closed with lint to prevent the entrance of blood, and the patient lying down with the head supported by a pillow, a flap was raised from the forehead, as shown in Plate XVII. Fig. 4, the skin being divided at a single sweep of the knife, the blade of which was inclined outward so as to cut a beveled edge. The apex of the flap, which was about five-eighths of an inch wide, rested between the eyebrows, and the tongue-like portion which was to form the columna nasi extended up into the scalp. The base of the flap was nearly three inches wide, in order to allow for its subsequent contraction. The flap, after being dissected up, was then turned down on the left side and wrapped in linen, while the wound in the forehead was closed by four interrupted sutures, after which the flap was applied to the freshened edges of the new lip and gums, the whole being held in position by the plastic suture before described, and tied over rolls of adhesive plaster, as in Græfe's method, Plate XVII. Fig. 5. Union having occurred, the pedicle of the flap was divided, five weeks subsequently, by passing a director under it, after which it was smoothly fitted down to the roots of the ossa nasi, in a cavity which was made for its reception by excising a portion of the subjacent integuments. By the twelfth day union was perfect, and the patient left the hospital so much improved that, sixteen months subsequently, his likeness was taken, as represented on Plate XVII. Fig. 6.

Remarks.—This very fortunate case, though forcibly illustrating the skill of the operator, can only be regarded as an example of the successful cases, and, though it may stimulate others to repeat it, should not induce any surgeon to be sanguine in his general prognosis of this class of operations.

Taliacotian Operation.—In the Italian, or Taliacotian operation, as it is more frequently termed, the nose, upper and lower lips, or ear, have all been restored by means of flaps taken from other portions of the body, and especially from the integuments of the arm.

In operating for the restoration of a nose, Taliacotius made two parallel incisions in the integuments of the arm over the belly of the biceps muscle, at such distances from each other, and of such lengths, as seemed likely to furnish a sufficient flap, allowance being made for the subsequent shrinking of about two-thirds of the portion taken, cutting it so as to free the skin from the fascia. The incisions corresponded with the vertical portions of the letter H; or he elevated the skin by broad forceps, and then transfixed it, as in the ordinary introduction of a seton in the neck. In either case, after passing the knife beneath the skin from one incision to the other, he introduced a piece of linen spread with cerate in order to prevent adhesions between the flap and the subjacent parts, and allowed the wound to suppurate for ten or fifteen days, in consequence of which a contraction of the width of the flap was effected, while it was also thickened and rendered more organizable. A bandage, consisting of a jacket, with a hood for the head, and a sleeve to contain and support the arm, Plate XVI. Fig. 5, with bands to hold it fast to the head, so that the flap could be steadily kept attached to the nose, being next prepared, the edges of the surface to be restored were freshened by paring off the cicatrix, by means of a thin and broad-bladed knife, the flap freed from the arm by its upper extremity, the arm brought up to the head, and the fresh end of the flap attached to the raw surface of the nose by means of numerous points of the interrupted suture; after which the bandage was tightened, and the arm left attached to the head, as seen in Plate XVI. Fig. 5.

After fifteen or more days, when union had taken place, the attachment of the flap to the arm was divided and trimmed so as to fill up the remainder of the deficient portion, this end being retained in its position by a few turns of a bandage, passed from the head around the nose, lip, or ear, according to the part operated on.*

Remarks.—This operation, though applicable to all parts of the face, is especially adapted to the restoration of the tip of the nose, the loss of portions of the lips and ears being more readily supplied by flaps taken from the adjacent parts by either sliding or rotating them upon their base.

With some slight modifications, the Taliacotian operation was successfully performed by Mason Warren, of Boston, in April, 1840.† In this case the flap was separated from the arm on the fifth day, union having then occurred.

By a modification of the French method, Pancoast, of Philadelphia, has also succeeded in restoring the middle of the nose, together with the ala of the left side. In this case a great portion of the hard palate, the sockets of the upper incisor teeth, the cartilaginous septum, superior lateral cartilages, inferior turbinated bones, together with a considerable portion of the inferior oval cartilages, and the integuments of the nose, had been destroyed by scrofulous ulceration, the tip and margin being drawn upward and also depressed inward by the cicatrization, Plate XVIII. Fig. 3.

Pancoast's Operation.—The patient being laid on a table, with his head supported by pillows, the integuments of the depressed cicatrix, just below the ossa nasi, were dissected off so as to obtain a beveled raw surface to receive the margins of the flaps, and the end of the nose separated from the ossa nasi by pushing a sharp-pointed, straight bistoury, with the back to the cheeks, across the cicatrix, and cutting outward. It was also found necessary to divide some adventitious adhesions within the nostril, and to extend the incision of the cheek outward and downward through the root of the oval cartilages, before the tendency to retraction of the tip could be overcome.

A triangular flap of integuments being then marked out on each cheek, just below the malar protuberance, of a size calculated to fill the breach, the outer limb of each triangle was rounded so as to give a prominence to the ridge of the nose, when the base of the flaps were brought together, and the edges of the flaps beveled inward toward their centre, in order to furnish an oblique surface, by which they might rest in the raw edges of the nose, Plate XVIII. Fig. 4. Being dissected up with as much subcutaneous areolar substance as could be taken without involving muscular fibres, the hemorrhage was arrested by torsion, and the flaps so twisted upon the pedicle, from below upward, as to make the lower margin of the flap on the cheek become the upper on the nose.

The flaps were then united by their bases upon the dorsum of the nose,

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* Gasparis Taliacotii Borroniensis. De Curtorum Chirurgiæ per insitionem, additi cutis traducis, instrumentorum omnium atque deligationum iconibus et laterilis. Venetiis, 1597. This book, together with many other rare and ancient medical works, may be found in the Loganian portion of the Philadelphia Library.

† Boston Med and Surg. Journ., vol. xxii. p. 261.

PLATE XVIII.

RHINOPLASTIC OPERATIONS.

Fig. 1. Restoration of one-half of the Nose and part of the Cheek by a flap taken from the Forehead. *After Pancoast.*

Fig. 2. Side view of the same with the Flap in *sitû*, showing the arrangement of the sutures upon the cheek. *After Pancoast.*

Fig. 3. Likeness of a Patient operated on for the removal of a Deformity caused by the destruction of the hard Palate, Septum Narium, and all the soft parts of the Nose, with the exception of the lip and columna, these being distorted and fastened to the lower end of the ossa nasi. *After Pancoast.*

Fig. 4. A view of the Gap left in the Nose of Fig. 3, after the dissection of the cicatrix and depression of the tip of the nose. The outlines of the flaps cut from the cheeks to fill up the gap are also shown. *After Pancoast.*

Fig. 5. A side view of the same, showing the application of the Sutures and the closure of the wounds left in the formation of the flaps. *After Pancoast.*

Fig. 6. A front view of the same, showing the arrangement of the Twisted Sutures to both the nose and the wounds left in the cheeks. *After Pancoast.*

Fig. 1

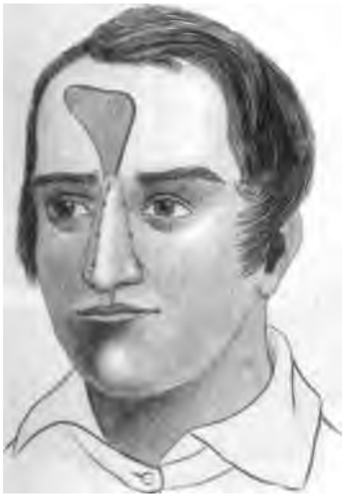
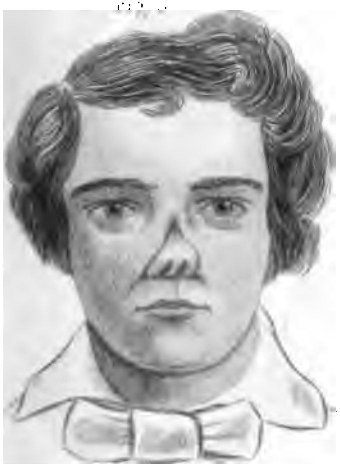


Fig. [illegible]



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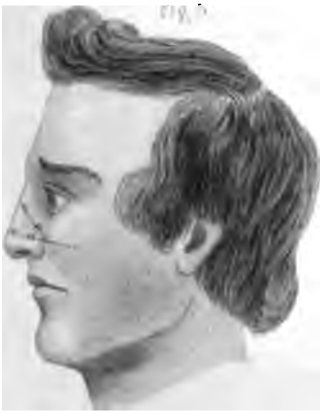

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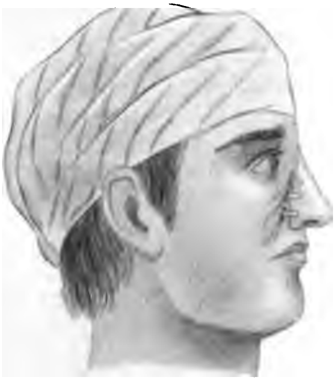

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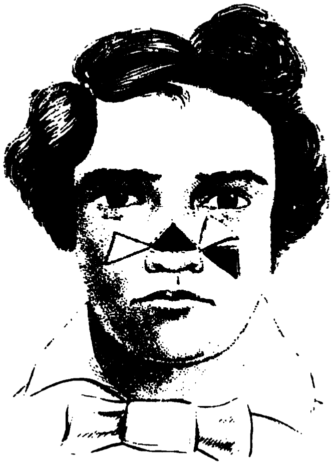
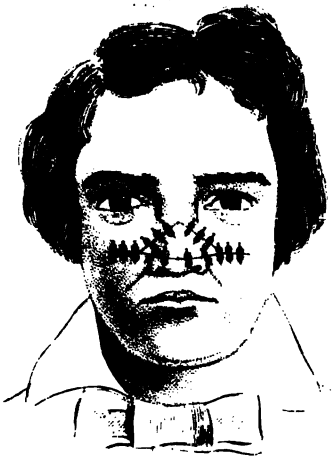


Fig. [illegible]



and by their sides to the adjoining parts, Plate XVIII. Fig. 6, by small palladium pins and the twisted suture. The nostrils were lightly stuffed with oiled lint, and the wounds on the cheek united by hare-lip sutures, applied so that the stress should be toward the canthus of the eye, and not upon the middle of the eyelid, which might have caused ectropion, when lint, wet with warm water, and covered with oiled silk, completed the dressing. At the first change of dressing, complete union was found to have taken place everywhere except at the median line, where there was some suppuration.

After some further additions to remedy defects arising from ulceration and contraction, the nose, ten months after the operation, looked quite natural.

Restoration of the Alæ Nasi may be accomplished either by a half flap of the Indian method, by the Taliacotian operation, or, if the loss is very limited, by a piece taken from some other part, and immediately attached in the opening, an operation which has fully succeeded in the hands of Mason Warren, of Boston.*

Restoration of the Columna Nasi.—Liston's Operation.—In deficiency of the columna nasi, Liston took the flap from the upper lip in the following manner: The point of the nose being raised, and its apex freshened at its attachment, by two vertical incisions on each side of the centre of the lip, he cut a flap of the entire thickness of the part, wide enough to allow of shrinking, when the frænum being freely dissected off, the flap was everted upward, so that its mucous membrane presented outwardly. Then removing the membrane from the top of the flap, the latter was attached by a pin, through its end, to the apex of the nose, and fastened by the twisted suture, uniting the lip as in the hare-lip operation. Exposure to the air soon changed the mucous membrane, and after a time it resembled the original structure of the columna.†

For many other plastic operations, and for much valuable experience, the reader may advantageously consult the papers quoted in the Bibliography of this part, all of which contain drawings explanatory of the various steps in the operations, and are creditable specimens of the ingenuity of the surgeons in relieving shocking deformities.

Value of these Operations.—In estimating the value of Rhinoplastic operations generally, and especially those for the restoration of the entire nose, much must depend upon the nature of the deformity. Most frequently, or when the operation is at all proper, the deficiency will be very great, and under such circumstances even an imperfect-looking nose will be deemed by most patients better than none. But when it is remembered that the integument of the new organ will retain most of the ordinary appearances of skin, while that of the natural nose possesses a large number of follicles; that the hair upon the flap is apt to grow and require the frequent use of the tweezers for its extraction; that the new nose will generally be paler than the surrounding skin, and that, except in the Taliacotian operation, a cicatrix of some size will be visible at the part from which the flap has been taken, the surgeon may well hesitate and think whether, with the risk of failure or an imperfect success, it may not be better to import from Paris, or elsewhere, an artificial nose, the manufacture of which has now attained considerable perfection. If, on its reception, the patient's vanity is not gratified, the operation may then be undertaken with less chance of censure, should the result not entirely correspond with his or her anticipations. In the successful cases, which are those mainly reported, there is certainly great cause for satisfaction; but, as this class of operations has been at different periods lauded highly, and then fallen into disrepute, is it not probable that the number of failures, or abortive attempts, will again throw it into comparative oblivion? Plastic operations for the restoration of small deficiencies have been and are positive triumphs of science; but those for the restoration of an entire nose are by no means so well established, notwithstanding the renown(?) attached to the successful cases. In most of those coming under my notice, the so-called "new nose" was an ugly appendage to the face.

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* Boston Med. and Surg. Journ., vol. xxii. p. 268, 1840.

† Liston's and Mütter's Surgery, p. 168. Philad. 1846.

CHAPTER V.

DISORDERS OF, AND OPERATIONS ON, THE NASAL CAVITIES.

SECTION I.

ANATOMY.

The **internal nose** consists of two large fossæ in the middle of the superior maxillary bones, which present a very irregular surface. These fossæ or cavities are separated by the vertical septum, which, in the natural condition of the part, is a plane surface, and corresponds with the inner side of the nostril. The upper part of each fossa is formed by the cribriform plate of the ethmoid bone, the cells of which diminish very much the width of this portion of the cavity, so that the space between the upper and middle turbinated bones and the septum narium is frequently not more than three lines.

The bottom or floor of the nostril is formed by the palate process of the superior maxillary and palate bones, and is concave and about half an inch wide.

The external face is very irregular, presenting a number of convexities or prominences, Plate XIX. Fig. 1, which are intended to afford a greater surface for the lining or olfactory membrane. Among these prominences, that caused by the convexity of the inferior turbinated bones is very apparent, and tends much to diminish the breadth of the nostril throughout its whole depth. The middle meatus of the nose, or the space between the middle and inferior turbinated bones, contains the orifice of the antrum Highmorianum. This orifice is usually placed about the middle of the bone, but its precise situation and direction are so uncertain that it is found with some difficulty in the subject, though quite apparent in the skull.

The inferior meatus of the nose is between the lower turbinated bone and the floor of the nostril. At the anterior part of this meatus, about five lines from the anterior extremity of the turbinated bone, is the orifice of the ductus ad nasum.

This orifice is found at the upper part of the inferior meatus, about eight lines from the floor of the nostril.

The mucous membrane lines the whole nose, penetrates into the several sinuses and cavities communicating with it, and is continuous at the nostrils with the skin, and at the posterior nares with the lining membrane of the pharynx.

The posterior orifice of the nostrils, or the posterior nares, is divided, like the anterior, by a vertical septum, (vomer.) Its perpendicular diameter is about an inch, but its transverse diameter is only six lines, (Velpeau;) points which should be remembered in the introduction of the tampon for the arrest of epistaxis.

SECTION II.

DISEASES OF THE NASAL CAVITIES.

§ 1.—Ozaena.

Ozæna—οζω, I smell of something—may be defined as an unhealthy inflammation of the Schneiderian mucous membrane, which is generally connected with disease of the periosteum, or with caries or necrosis of the bones of the nose, and is very frequently a result of syphilis.

Symptoms.—The symptoms of ozæna are, first, those of coryza; but the discharge presently becomes profuse, then muco-purulent, and then rapidly assumes the stinking odor which is characteristic of the disease, and from which it is named. Sometimes the ulceration of the mucous membrane is deep, and involves the bones, spreading rapidly and casting off scales of bone, when, if the disease is syphilitic in its character, the nasal bones fall in, and produce all those deformities which have been alluded to in connection with secondary syphilis.*

Diagnosis.—The diagnosis of ozæna may be made by noticing that it is characterized by a fetid discharge from the nostril, though such a discharge will also sometimes take place in children, particularly those who are scrofulous, but in whom it is unaccompanied by any disease of the bone; a point which renders the diagnosis comparatively easy.

Prognosis.—The prognosis of ozæna will depend very much upon its causes and complications; if due to syphilis, the prognosis will be unfavorable, and in all cases should be guarded, lest the caries of the bones create deformity and the entire destruction of such as are involved.

Treatment.—The treatment of ozæna should be both constitutional and local. If the disease arises from a tuberculous taint, or is due to syphilis, the general treatment adapted to these conditions will, of course, be necessary; while, if the patient is weak and exhausted, tonics and chalybeates will be imperatively demanded. The local treatment should be conducted upon general principles; thus, as there is ulceration of a mucous membrane, which is more or less connected with disease of the bones, alterative and astringent washes may be expected to prove serviceable, especially weak solutions of the salts of lead, which, being thrown into the nostril, diminish the fetor by combining with any free sulphuretted hydrogen which may be present. The strength of a solution of acetate of lead for this purpose should be from five to ten grains to the ounce of water. The mild chlorides are also serviceable in the same manner, such as the chloride of soda in the form of Labarraque's solution. I have obtained much benefit in several cases from the use of chloride of lime, in the proportion of two drachms to the ounce of water, as suggested by Horner. In those cases accompanied by the discharge of a scab each morning, I have derived benefit from injecting into or painting the nostril with glycerin, or with melted chicken fat or goose grease, as advised by Physick. Advantage will also be found from the alterative effects of solutions of nitrate of silver. But when the caries or necrosis of the turbinated and other bones has gone to any extent, the disease will often prove exceedingly intractable.

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* Vol. i.

§ 2.—Rhinolithes.

Rhinolithes is the name given to nasal calculi, or little concretions, which consist generally of inspissated mucus and some of the phosphates. They may be of various sizes, from that of a pea to that of a bullet, or a little larger, and should be removed from the nose in the same manner as any other foreign bodies; they are, however, very rarely met with.

§ 3.—Foreign Bodies in the Nostril.

Foreign Bodies in the nostril may be of various sorts and sizes, as beads, pieces of ribbon, peas, grains of coffee, or any other articles likely to be thrust up the nostril by mischievous children. Grains of coffee, which are sometimes introduced, are particularly troublesome; because, imbibing moisture from the part, they swell, and may thus not only become firmly imbedded, but also produce displacement or fracture of the turbinated bones, or even fracture of the vomer.

Treatment.—To get rid of these foreign bodies, a pair of forceps may be used, if properly curved to suit the nostril, the instrument being introduced into it close to the septum, in order to avoid the inferior turbinated bone, when a little manipulation will enable the surgeon to seize the foreign body and withdraw it. Foreign bodies may also sometimes be extracted by means of a probe bent into the shape of a hook; or their removal may frequently be accomplished by the use of the syringe, which is a better plan. Sometimes it will be necessary to push the foreign body backward into the posterior nares and extract it from behind the soft palate.

§ 4.—Abscess of the Septum Narium.

The presence of foreign bodies and other causes, most of which are not understood, sometimes produces abscesses in the septum narium, the seat of which is in the areolar substance found between the two layers of cartilage of which the septum is formed. The result of such an abscess is, of course, a separation of the two layers of the cartilage, in consequence of which the patient soon notices such a bulging of the septum toward one or the other nostril as creates a deformity.

Treatment.—The treatment is simple, the abscess being punctured and treated as abscesses elsewhere, the chief danger being from the continued distention of the cartilages inducing a condition of the septum narium which will cause permanent deformity. The ulcer left after the evacuation of the abscess should be stimulated by nitrate of silver or other alterative applications, and when, as a consequence of the complaint, dryness of the nostril occurs, glycerin may be used.

SECTION III.

OPERATION ON THE NASAL CAVITIES.

§ 1.—Arrest of Hemorrhage from the Nostril.

Bleeding from the nostril, when excessive, and when the use of powdered galls or tannic acid, or matico, or gum-arabic, or alum, or diluted persulphate of iron has failed, may usually be arrested by plugging up both the anterior and posterior extremities of the nostrils so as to prevent the escape of the blood, and cause the formation of a clot.

Plugging the Nostril with Bellocque's Canula.—This instrument—see Plate XIII. Figs. 25, 26—consists of a curved silver tube, in which is placed a piece of watch-spring of sufficient length to reach from the uvula to near the front teeth. To one end of this spring is attached a silver button, with an eye capable of readily receiving a ligature; to the other is screwed a probe, which is intended to push out the spring.

Operation.—After preparing a little pellet of charpie, of a size corresponding with the opening in the posterior nares, and after passing a long ligature through the eye of the button at the end of the spring, and drawing the latter fully within the canula, pass the tube along the floor of the nostril, keeping it close to the side of the septum, until it reaches the uvula. Then, pushing forward the spring, the button will readily pass into the mouth, its passage in front of the uvula being facilitated by the forefinger introduced into the mouth. When the button is near the teeth, one end of the ligature should be drawn out of the mouth, and the pellet of charpie attached to it by tying the ligature round its middle, Plate XIX. Fig. 1. Then, on drawing back the spring into the canula, and removing the latter from the nose, the pellet will be drawn up into the posterior nares, so as to leave one end of the ligature in the mouth and the other in the nostril. It only remains to plug up the front of the nostril, and tie the two ends of the ligature rather loosely in a loop near the teeth, or to carry them toward the cheek and fasten them with adhesive plaster.

Should the surgeon not be able to obtain Bellocque's canula, he may readily carry a ligature through the nostril and mouth by means of a common elastic catheter; the ligature being passed through the eye of the instrument, and the latter withdrawn after the pellet is in position. In either case, after the lapse of several hours, the lint in front of the nostril should be removed by the fingers or forceps, and that from the posterior nares displaced either by pressing it into the throat by a probe, whence it may be drawn by the thread left attached to it for this purpose, or it may be drawn out by traction on the end of the ligature left in the mouth.

§ 2.—Polypi in the Nostrils.

Pathology.—Various divisions of **Polypi** have been described by writers, and especially by Dupuytren, in all of which more attention has been given to their consistence than to their general pathological characters. In an excellent paper by Watson, of New York,* much has been added to our knowledge of the origin and structure of these tumors, and I cannot present

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* Amer. Med. Journ., vol. iii. p. 325, New Series, 1842.

PLATE XIX.

ANATOMY OF THE INTERNAL NOSE, WITH THE OPERATIONS FOR NASAL POLYPI.

Fig. 1. A vertical section of the Head, in its median line, so as to show the interior of the Nose, Mouth, and Throat. 1. The middle turbinated bone. 2. Inferior turbinated bone. 3. Anterior and cartilaginous portion of the nostril. 4. Middle palatine suture. 5. Roof of the mouth. 6. An ear catheter passed along the floor of the nostril and entering the orifice of the Eustachian tube. 7. Middle meatus of the nose. 8. Inferior meatus, near the nasal orifice of the ductus ad nasum. 9. The sound of Laforest introduced into the duct. 10. Section of the uvula. 11. Bellocque's canula passed along the floor of the nostril and soft palate, behind the uvula into the pharynx. The spring has been protruded, and the ligature with the pellet of charpie attached is about to be drawn back into the posterior nares in order to close one side, as in tamponing the nostril. 12. The epiglottis cartilage. 13. Section of the œsophagus. 14. Genio-hyoglossus muscle. 15. Origin of the genio-glossus muscle. 16. Section of the lower jaw at the chin. 17. Structure of the chin. 18. A probe introduced into the buccal orifice of the duct of Steno. *After Bernard and Huette.*

Fig. 2. A front view of the manner in which the loop is seized and drawn forward in the operation of tamponing the nostril. *After Bourgery and Jacob.*

Fig. 3. A vertical section of the Nose, showing the application of a ligature around a guttural polypus by means of the "porte ligature" of Charriere. 1. The ligature passed in a loop through the nostril. 2. The "porte," which has seized it in the pharynx, and directed it around the base of the tumor. This instrument opens at the end by means of a spring, so that it can seize or be detached from the ligature without difficulty. The forefinger of the surgeon will often do quite as well. *After Bernard and Huette.*

Fig. 4. Section of the Face, so as to show the removal of a pyriform nasal polypus, by means of the wire ligature and double canula as practiced by Physick. *After Bell.*

Fig. 5. A side view of Mott's operation for the removal of a large nasal polypus which filled the entire nostril. The integuments have been incised and dissected back, while the dotted lines show the course of the saw through the bones. *After Mott.*

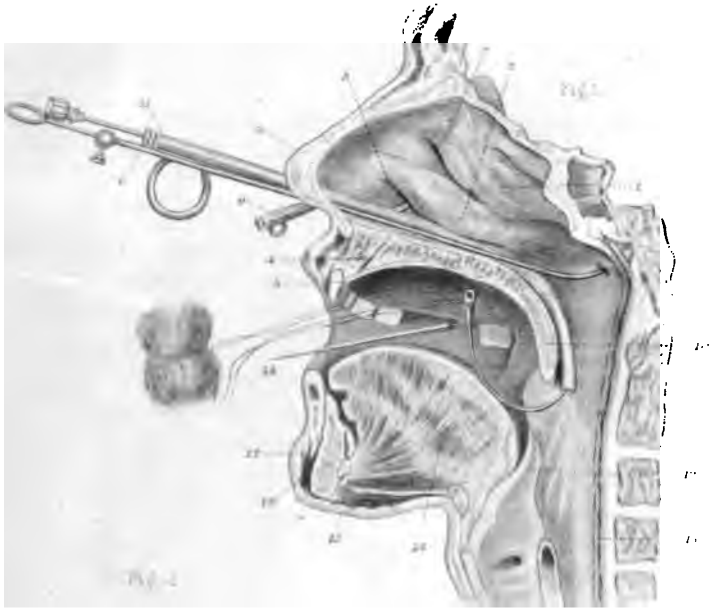
Fig.1
Fig.2

Fig.3

the reader with any details more valuable than those furnished by his article. From this the following account is condensed.

Kinds of Polypi.—Six kinds of polypi may be noticed in connection with the surgical affections of the nostril.

1st. The mucous or soft polypus, caused by the accumulation of mucus within the muciparous follicles, and arising either from a change in the consistence of the mucus itself, or from obliteration and obstruction of the ducts; resembling, in this respect, the sebaceous and encysted tumors of the scalp and other portions of the body, all of which, like polypi, may become pedunculated if acted on by the weight of the contents of the sac.

2d. The polypus from hypertrophy, induration, and infiltration of the mucous and submucous tissues of the nostril, and similar to the tumors frequently seen near the lower part of the rectum. These tumors are, in fact, a prolapse of the thickened and infiltrated Schneiderian membrane, and attended with an effusion of fluid into the subjacent connective tissue, as the result of inflammation.

3d. Fleshy polypi, or caruncular excrescences, of a florid red color, and though not painful, except when irritated, are possessed of a certain degree of sensibility. These are less disposed to assume a pedunculated attachment than any other benign form of polypi. Similar growths have been found at the inner edge of the meatus urinarius of the female, and in the external meatus of the ear, by Sir A. Cooper, and others have seen them in the rectum.

4th. Fibrous polypi, supposed by Velpeau to have their special origin in the fibrous tissue covering the bones in the nasal cavity, and to lie between the bone and the proper mucous tissue. When very large, these are usually found projecting into the posterior fauces, though the other forms may also project either forward or backward. These tumors are invariably attached by a firm and fibrous pedicle.

5th. Gelatinous polypi, which are of rare occurrence. In one case, the disease appeared to have originated in the antrum between the mucous membrane and the bone, and then to have encroached on the surrounding parts. It was surrounded by a sort of imperfect capsule, with subdivisions of areolar tissue, some of which were exceedingly delicate, and all of them filled with a gelatinous, semi-fluid substance of a transparent, pale-white or amber color. At some points, this matter was more like soft calf's-foot jelly, without any visible envelope, but here and there the tumor contained opaque, grumous, bloody deposits. The bones retained their proper character, and had not degenerated, and all the surrounding tissues were simply affected by the pressure of the tumor.

6th. External polypi, generally called lipoma, and referred to in a previous page.

7th. Carcinomatous polypi, most frequently originating in the periosteum or bony structure of the upper jaw, and, sooner or later, invading and deranging the surrounding tissues.

Seat of Polypi in the Nose.—This is to be ascertained mainly through dilatation of the nostril, by introducing the blades of the dressing forceps, or by a speculum, or by directing the patient to blow through the nostril so as to force the polypus forward.

Most frequently polypi arise from the mucous membrane spread over the turbinated bones, or near the orifice of the maxillary sinus, being seldom found on the septum, and also as rarely arising from the floor of the nostril. The first two forms are generally confined to the tissues lining the external and upper wall of the nostril. The third form, though not so strictly limited, is often found near the external orifice of the nostril, at or below the turbinated bones. The fourth is most frequently found to arise in the posterior fauces immediately behind the top of the septum, or probably from the septum itself.* In a case which I attended some years since, the tumor extended from this point along the body of the sphenoid bone, and left it perfectly denuded of its periosteum, as was shown after its removal.

The fifth, or gelatinous polypus, as already seen, arises in the antrum Highmorianum; and the sixth, though frequently arising on the nasal surface of the upper maxillary bone, is restricted to no definite point of attachment.

Symptoms.—The symptoms of soft polypus in the nose are well marked. The patient complains of feeling something in his nostril, and has, therefore, a constant desire to blow his nose, from which he finds a thin mucous discharge. He also notices that he breathes through the nostril more freely in dry weather than in moist. As the polypus grows, the symptoms become marked, its bulk encroaching upon surrounding parts, until it may at last block up the entire nostril, and so press on the orifice of the ductus ad nasum as to prevent the passage of the tears into the nose. In consequence of this the tears will often overflow the eye, and the patient, being ignorant of the true cause, refers all his symptoms to a troublesome coryza, which he is not able to get rid of. As the tumor grows still larger, it may protrude from the nostril anteriorly, and show itself externally, or it may project backward through the posterior nares into the top of the pharynx; or it may work its way, if its growth still continues, through the fissures in the bones of the face, and appear in parts apparently wholly unconnected with the nostril; thus tumors have been produced in the temple as a result of an excessive growth of one of these soft polypi in the nose. Another symptom which, so soon as the polypi have attained any size, develops itself in a very marked manner, is an alteration in the voice, which assumes a peculiar nasal twang, on account of the obstruction of the nostrils interrupting the reverberation of sound, the patient speaking as he would do if he held his nostrils between his thumb and finger.

Upon looking into the nose this polypus can generally be seen as a smooth, pinkish swelling, owing to its being covered by the Schneiderian membrane; but caution must be used lest the anterior extremity of the inferior turbinated bone be mistaken for the polypus, when it projects toward the anterior nares.

The **fleshy, fibrous,** or **hard polypi** present characters which, in many respects, correspond with the variety that has just been described; thus, they have a tendency to grow rapidly and invade the surrounding parts, producing, by their pressure, caries and necrosis of the bones with which they come in contact. Those of the bones thin enough—as the walls of the antrum under certain conditions—are also apt to become distended, and the patient is horribly deformed, creating a distortion of the features, which has been designated as "frog-face," Fig. 398.

Prognosis.—The prognosis of soft polypi in the nostril is favorable, as the tumors can generally be removed, and although they will frequently return, yet they can be removed again and again, until the tendency to their reproduction is finally overcome, unless they be malignant or have induced serious organic changes in the adjacent parts.

Treatment.—The treatment of soft polypi may be either palliative or radical; the palliative consisting in puncturing the tumor with a sharp-pointed bistoury, evacuating its contents, and allowing it to collapse. Although this treatment is in the majority of cases only palliative, yet it is not unfrequently followed by destruction of the sac and a disappearance of the disease.

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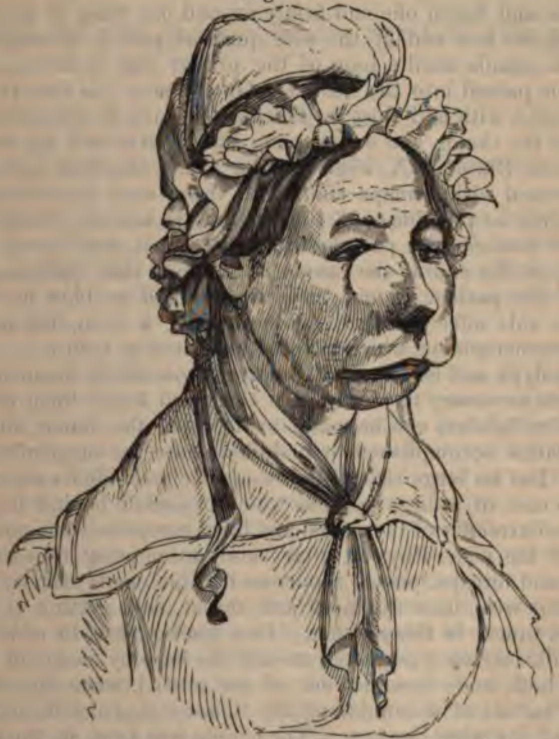
* Watson, *loc. citat.*

Should, however, this not happen, as is more frequently the case, the sac will begin shortly to refill, and resort must be had to the operation of extirpation as a means of effecting a radical cure, as hereafter stated.

Sometimes a polypus can be removed simply by causing the patient to sneeze violently, when, in the efforts consequent upon this action, the tumor will be expelled by being torn off from its base by the air as it is forcibly driven through the nostril.

Fig. 398.



Frog-face, or the deformity caused by Polypi of the Nose encroaching on the bones of the face. (After Liston.)

To produce this effect, ordinary snuff may be employed, or one of a more stimulating character, as powdered sanguinaria, cloves, rhubarb, or powdered sage, though any active sternutatory will answer the purpose. Having by any of these means gotten rid of the tumor, any wash which is astringent and alterative in its character may be used as an injection into the nostril, with a view of preventing the reproduction of the complaint—the best of these being the nitrate of silver. When the latter salt is used, the precaution should be taken of anointing the upper lip and the orifice of the nostril with sweet oil, in order to prevent the wash from discoloring the skin.

The extraction of the soft polypi may be attempted either by the polypus forceps, by the wire ligature and double canula of Physick—Plate IV. Fig. 12—or by the knife; caustics, sternutatories, etc. being comparatively limited in their application, or resorted to either as palliative means, or as adjuvants to other plans of treatment.

Removal by the Forceps.—The patient being directed to blow his nose, and being seated before a good light, with his head well supported, introduce the forceps closed, and with the width of the blades corresponding to the vertical diameter of the nostril, grasp the tumor as near as possible to its base, then, rotating the instrument in the hand so as to twist the tumor, pull it away with a jerk as soon as it is felt to yield to the torsion movement.

Strangulation and Extraction by the Wire Ligature and Double Canula.—This plan, which is that most frequently resorted to in the United States, and which is the least liable to injure the bony structure, is practiced as follows: Pass a piece of well annealed iron wire through the barrels of the canula, and fasten one end firmly around one wing of the instrument. Then, seizing the free end of the wire, push or pull it through one of the barrels of the canula until a loop of the proper size is formed at the end which is to be passed into the nostril. On carrying this into the nose with the loop parallel with and close to the septum, turn it transversely beneath the fundus of the tumor, and endeavor to slide it over and up to the pediculated portion, Plate XIX. Fig. 4; after which the free end of the wire should be seized with forceps similar to those used by bell-hangers, and drawn as tightly as possible. If the polypus is not too dense in its structure, this will constrict its pedicle to a mere shred, and it only remains to tear it away at the end of the canula, in the loop thus tightened. After a few minutes, the patient should be again directed to blow his nose, especially on the side affected, when, again forming a loop, fish about in the nostril for another tumor, which is to be extracted as before.

In large polypi, and especially where they protrude by the posterior nares, it may become necessary to strangulate them and leave them to slough off. When the wire ligature can be made to surround the tumor, the more perfect strangulation accomplished by it should cause the surgeon to give it the preference. But its large size will occasionally preclude its use in this manner. In the case of a large polypus which projected behind the soft palate as low as the extremity of the uvula, and filled completely the posterior nares and cavity of the nose, Physick, after vainly attempting to extract it with the ligature and forceps, passed a portion of tape, made stiff by means of a piece of silver wire, into the nose and throat, and, getting it around the base, tied the tumor in this manner. In a similar case, in which I assisted Gibson, a violin string was passed around the base by means of Bellocque's canula, and both ends brought out of the nostril, when they were passed through the barrels of a canula and the tumor strangulated, as in the usual application of the wire ligature. The canula was kept in the nostril until the third or fifth day, when the tumor sloughed off.

Operation of Mott.—In a large fibrous polypus, which filled the nostril, Mott removed the tumor, after the ligature had failed, by making a section of the soft parts from the inner canthus of the eye to near the angle of the mouth, and sawing out the greater part of the os nasi, ascending ramus of the superior maxillary and inferior turbinated bone,* Plate XIX. Fig. 5.

Excision.—Except in the very rare cases of exceedingly firm polypi, or those near the nasal orifice, this operation can seldom be required. When resorted to at the anterior orifice, the tumor should be hooked forward, and excised either with a probe-pointed bistoury, or with scissors, though the first is preferable.

In all these operations, if the subsequent hemorrhage is excessive, tamponing the nostril may be required.

Value of these Operations.—In most cases of soft polypi, the wire ligature and double canula will prove most serviceable, next the forceps, and lastly excision, especially of the fibrous variety.

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* Am. Journ. Med. Sciences, vol. v. p. 87, 1842.

CHAPTER VI.

DISORDERS OF, AND OPERATIONS ON, THE LIPS AND MOUTH.

SECTION I.

ANATOMY OF THE EXTERNAL PORTION OF THE MOUTH.

In studying the parietes of the mouth, two parts are to be separately noticed: first, its orifice as formed by the lips, and, second, its sides as constituted by the cheeks. The tissues composing both these portions are the skin, areolar tissue, fat, blood-vessels, muscles, and nerves, together with the mucous membrane.

The skin and areolar substance present nothing requiring a special description. The muscles of this region are the orbicularis oris, closing the orifice of the mouth; the zygomatici and levatores anguli oris, which draw back its angles; the buccinator, which dilates its cavity, and forms the greatest portion of the sides of the cheek; and the masseter, which assists in closing the jaws, being inserted into the lower jaw in advance of its angle. The depressors and levators of the lips complete the enumeration.

The principal blood-vessels are the facial artery and vein, with their branches, both of which pass on to the face, side by side, over the surface of the inferior maxilla, directly in advance of the anterior edge of the masseter muscle; being at this point quite superficial, they may be readily compressed by the pressure of the finger against the jaw just in advance of the muscle. The nerves are the branches of the seventh pair, (portio dura,) which are widely distributed over the face after the trunk emerges from the parotid gland —Plate XXIV. Figs. 1, 2—and the infra-orbitar, (second branch of the fifth pair,) which, coming out through the infra-orbitar foramen of the superior maxillary just below the middle of the orbit, is also freely distributed to all the tissues. Expression and motion are due to the portio dura, and sensation to the branches of the fifth pair.

The salivary glands, Plate XXIV. Fig. 1, although opening into the mouth, are yet so situated as to be rather intermediate to the head and neck; and the description may, therefore, at present be limited simply to their ducts as mainly belonging to the region under consideration, the position and operations practiced upon the glands themselves being reserved for the account of the neck, owing to the importance of their vascular connections with this part.

The duct of Steno, or the parotid duct, departs from the anterior edge of the gland, a few lines below the zygoma, traverses the outer face of the masseter, and perforates the buccinator muscle and the lining membrane of the mouth, so as to have its orifice opposite the second large molar tooth of the upper jaw, Plate XIX. Fig. 1. Its position may be accurately marked by drawing a line from the tip of the nose to the lobe of the ear. The duct of the submaxillary gland may be found opening by a small projecting orifice on the anterior margin of the frænum linguæ. The ducts of the sublingual open either into that of the submaxillary, or directly into the mouth, on either side of the frænum.*

The further details of this portion of the face, being of but little practical value to the surgeon, may be omitted, with a simple reference to the explanations of the figures, Plate XIX. Fig. 1, and Plate XXIV. Figs. 1, 2.

SECTION II.

OPERATIONS ON THE LIPS.

The operations upon the lips are chiefly those required for the cure of hare-lip, of cancer, of atresia or closure of the mouth, and for cheiloplasty or the formation of a new lip.

§ 1.—Simple Hare-lip.

The congenital defect of union in the two halves of the lip, termed **Hare-lip**, may usually be remedied by paring off or freshening the vertical portion of each half, and then uniting them by suture.

Various modes of accomplishing this have been proposed by surgeons, but differ mainly in the character of the incision. Without, however, referring to these in detail, this account may be limited to that which I have generally found successful.

Operation.—The child, being either firmly held, or with its arms bandaged to its side or tied up in a bag, the end of which is drawn around its neck, should be placed in a semi-recumbent posture, or, if lying down, raised up from time to time during the operation, so as to prevent the escape of blood into its throat and stomach, as this is apt to induce fever. Then, seizing the left half of the lip with the left forefinger and thumb, dissect it freely from its attachment to the gum, and, seizing the right half in the same manner, dissect it also freely from the gum, this free dissection of the lip from its attachments being essential to success, by diminishing the subsequent strain on the line of union. After freeing the lip very fully at this point, next introduce a spatula of shingle, or other soft wood, beneath the lip, and have its free extremity held by an assistant. Then, seizing the left half at its free angle with a tenaculum or forceps, extend the flap upon the spatula, and, commencing at the nostril, cut through the lip so as to make the incision to its lower edge in a slightly semicircular or bent direction, like an A jointed or bent outward at the cross-piece, the joint or angle being near but not quite in the centre, as proposed by Barton, of Philadelphia, and also by Guerin,† of Paris, Plate XX. Fig. 1. This edge of the lip being then seized by the assistant, the coronary artery may be compressed between the thumb and forefinger, so as to check the bleeding.

The opposite half being now treated in the same manner, the wound will exhibit two almost semi-elliptical cut surfaces, so arranged as to present their concavity toward the median line of the fissure, Plate XX. Fig. 1.

Then, passing a ligature through the lower edge of each flap, and drawing upon it, adjust accurately the angles of the incision to the same level, and, giving the ligature into the hand of an assistant, so as to preserve their position, pass a sharp-pointed steel or insect pin through the flaps from left to right, taking care not to carry it through the mucous membrane. After surrounding this pin with a twisted suture, next introduce a second or even a third pin, and approximate the surfaces of the incision well up into the nostril by other ligatures, Plate XX. Fig. 5, when the ligature first introduced at the lower edge of the lip, and which should have been held by the assistant during this time, may be withdrawn.

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* Horner's Anatomy.

† Gazette Médicale, June, 1844.

Dressing.—After cleansing the lip, and cutting off the points of the pins, the sutures should be firmly supported by strips of adhesive plaster, slit so as to allow the ends of the pins to pass through them, and extended from the middle of one cheek across the lip to the other cheek, in order to take the traction off from the pins. Three days subsequently, the latter must be withdrawn by a rotatory movement, without, if possible, disturbing the ligatures or plaster, as may be readily accomplished either by nicking the latter over the head of the pins, or by drawing them through the slits made in the strips previous to their application. On the fifth day, the cheeks being well supported by an assistant, these strips may be removed, and new ones applied every two days during the first week or until the union is accomplished. Throughout, or at least until the sixth day, the child, if unweaned, should be fed with a spoon; but after this it may be allowed to suck with the plasters on. During the first twenty-four hours after the operation, it is also especially necessary that the patient should be watched, lest hemorrhage occur, and the blood, escaping into the mouth, be carried into the stomach, without the bleeding being suspected. If, however, the pins are inserted in the lip deeply enough to pass behind the coronary arteries, the compression of these vessels by the ligature will allow but little probability of hemorrhage.

Remarks.—The advantages of the semi-elliptical incisions over those which are straight will be found in the absence of the notch in the lip, usually consequent on the contraction of the wound, the angular character of the incisions preventing the linear shortening of the cicatrix. The value of the temporary ligature in the free edge of the lip will also be found in the greater accuracy with which the angles can be adjusted before inserting the first pin.

Mirault, of Angers, France, operates as follows: By a straight incision, he pares off one-half of the fissure, Plate XX. Fig. 2. Then, incising the other portion, (generally the left,) he cuts it so as to leave a pedicle of the membrane on the free edge of this flap, which, being carried across the fissure and united to the opposite half, prevents the formation of any notch or depression, Plate XX. Fig. 3.

Malgaigne, in order to avoid the notch on the free surface of the lip, makes a curved incision from above downward, so as to pare off the mucous covering of the fissure, but without cutting it free from the inferior angle, or that continous with the margin of the lip. Leaving the portion thus pared off adherent, and depending by this pedicle, he unites the wound by pins and the twisted suture. Then, trimming and shortening the pediculated portion with the scissors until there is only a piece in each half long enough to fill up the notch, he unites them on a level with the lip by a small and fine pin.

Judging from personal observation, hare-lip is a very common complaint, it having occasionally happened to me to have three patients under treatment at one time; and in one winter at the Clinic of the University of Pennsylvania, I treated ten in the course of six months. Out of the large number that I have seen—I should think more than eighty—but two failures have occurred, after pursuing the plan above stated; and in one of these, (double,) the result was undoubtedly due to an attack of cholera in-

PLATE XX.

OPERATIONS PRACTICED ON THE LIPS AND MOUTH.

Fig. 1. A front view of a single Hare-lip, with the lines of the incision for freshening the edges as advised by Barton. 1, 1. The semi-elliptical incisions. *Modified from Bernard and Huette.*

Fig. 2. Operation of Mirault, of Angers, for single Hare-lip. 1. The flap cut from one side. *After Bernard and Huette.*

Fig. 3. The same operation, showing the line of union and position of the principal pin. *After Bernard and Huette.*

Fig. 4. Front view of a double Hare-lip, showing the septum or anterior edge of the intermaxillary bone, containing the two central incisor teeth. *After Bernard and Huette.*

Fig. 5. Application of the single Hare-lip Suture to the case shown in Fig. 1. *After Bernard and Huette.*

Fig. 6. The union of the parts, after the operation of double Hare-lip, when both sides are to be united at the same time. The risk of sloughing of the central part, from excessive inflammation or want of vitality, is an objection to this mode of operating. *After Bernard and Huette.*

Fig. 7. Atresia of the Mouth consequent on ulceration, showing Dieffenbach's operation. 1, 2. The integuments as left by the two incisions which start from 3, the mucous membrane remaining untouched. 3. Point for the introduction of the scissors. 4, 5. The lines of incision. The ulceration has exposed the gums and teeth at the opposite corner of the mouth. *After Bernard and Huette.*

Fig. 8. View of a Mouth, as contracted in consequence of an ulcer. 1, 2. The two points at which the sharp-pointed scissors were introduced so as to divide the integuments on both the upper and lower lip toward the median line. The mucous membrane, being subsequently divided, was reflected over the edges of the incision and fastened to the skin by several points of the interrupted suture. *After Bernard and Huette.*

Fig. 9. The appearance of Fig. 8 after the integuments had been removed. 1. The mucous membrane untouched. This is to be divided in the median line of the mouth, and reflected so as to form a rounded edge to the new lips. *After Bernard and Huette.*

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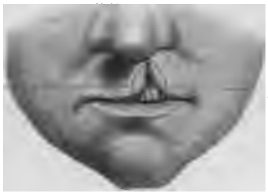
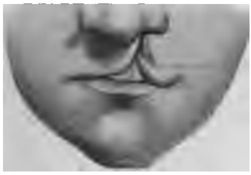
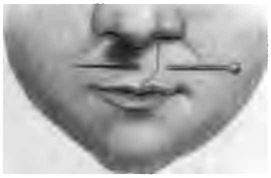
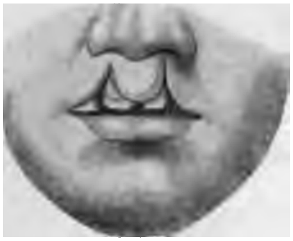
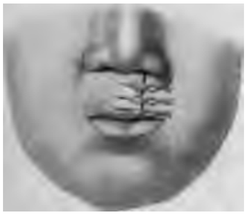
Fig. 1

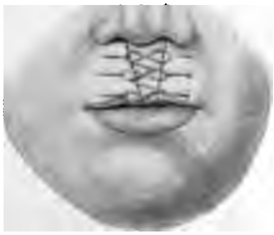












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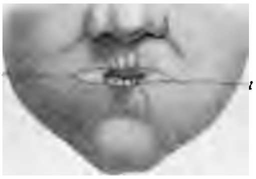

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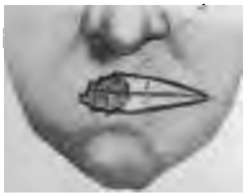

fantum, of which the child died. After the operation, as performed by the scissors and the ordinary straight incision, I have seen several (five?) failures. As respects the best period for the operation, I have generally selected the earliest possible time after the tissues seemed to be firm, usually soon after the third week of infancy; and I have always deemed it necessary to continue the adhesive strips a week after the removal of the pins.

Mason Warren, of Boston, as well as several other surgeons, select an early period for the operation; but resort to the interrupted suture in place of employing the hare-lip pins.

Peirson, of Salem, Massachusetts, has succeeded in several cases, on which he operated within the first twenty-four hours after birth; and advocates* this early operation as being especially advantageous, from the tendency of the infant to sleep at this period.

Guersent, Surgeon of the Children's Hospital in Paris, has also recently performed the same operation successfully on an infant only one day old.†

Mason Warren has permitted nursing during the process of healing, in the case of an infant one month old, on whom he had operated, and employed three sutures without inconvenience, it being evident that there was no strain on the lip during the act of sucking.‡ In two instances, I have operated successfully within thirty-six hours after birth, resorting to the lead suture and one hare-lip pin—the pin being placed on the level of the margin of the lip—but I always have the child fed.

§ 2.—Double Hare-lip.

In the variety of the disease known as **Double hare-lip** there is commonly a double fissure in the lip and palatine portions of the mouth, together with a tubercle or intermediate structure resembling and corresponding with the intermaxillary bone of animals, Plate XX. Fig. 4. The projecting extremity of this bone usually contains either the germs of the incisor teeth or the teeth themselves, according to the age of the patient, and is often a source of difficulty, by causing the interruption of the circulation through the middle flap.

Ordinary Operation.—If the central flap is to be preserved, it should be first freed from its attachment to the gum, but with judgment, lest its vitality be impaired from want of base. Then, one of its edges being freshened with the scalpel and wooden spatula, the opposite half of the fissure should be freed from its attachment and also freshened, as in the operation just detailed, the remaining portion of the operation being performed as in that for simple fissure. After a few weeks, when the union is firm, the remaining half of the lip may be operated on in a similar manner; or, if circumstances induce the surgeon to think it advisable, both sides may be united at the same time by transfixing them with the pins, as represented in Plate XX. Fig. 6.

Remarks.—Some surgeons prefer, in double hare-lip, the performance of the operation on both sides of the fissure at the same period; but, in my experience, this has seemed more liable to failure: 1st. Because the stress upon the pins, or upon the newly-formed cicatrices after their removal, is much greater when both sides are thus operated on. 2d. From the inflammation or compression of the middle flap by the ligatures being more apt

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* Bost. Med. and Surg. Journ., vol. xlvii. p. 134.

† South. Med. and Surg. Journ., vol. vii. p. 641.

‡ Amer. Journ. Med. Sciences, Oct. 1851.

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[*] Bost. Med. and Surg. Journ., vol. xlvii. p. 134.

[†] South. Med. and Surg. Journ., vol. vii. p. 641.

[‡] Amer. Journ. Med. Sciences, Oct. 1851.

PLATE XXI.

THE OPERATIONS OF CHEILOPLASTY AND GENIOPLASTY.

Fig. 1. A side view of Mütter's operation for the Formation of a New Cheek. The edges of the ulcer, which resulted from extreme salivation, were first freshened, the useless teeth extracted, and four flaps formed by incisions in the course of the dotted lines, so as to permit the approximation of the edges of the flaps. *After Mütter.*

Fig. 2. A three-quarter view of Mott's operation for the relief of Anchylosis of the Jaw dependent on Cicatrization of the Mouth, with the restoration of a part of the Cheek. 1. The cicatrix arising from an ulcer. This was entirely excised, leaving an opening in the cheek. 2. The tongue-shaped flap, cut to fill up the opening by being rotated upon its base. *After Mott.*

Fig. 3. A front view of Pancoast's operation for the removal of an extensive Cancer and the formation of a new Lower Lip. The cancer is shown as circumscribed by a curvilinear cut. A vertical incision in the median line of the chin extended from the curvilinear cut nearly to the os hyoides, and another, which was horizontal and parallel to the base of the lower jaw, formed four flaps. The angles of the flaps being removed, the upper flaps (1, 2) were raised to the proper level, and united by the twisted suture on the median line, when the lower flaps (3, 4) were also united on the median line so as to cover the front of the chin. *After Pancoast.*

Fig. 4. A front view of Chopart's operation for the same object. 1, 5, 3, 6. The vertical incisions. 2, 4. The horizontal cut circumscribing the disease. 2, 4 is to be raised to the level of 1, 3. *After Bernard and Huette.*

Fig. 5. Operation of Lallemand for closing the gap left by the excision of a Cancer which involved the angle of the Mouth and a portion of the Cheek and Lower Lip. 1. The remaining portion of the lip, which is to be drawn over to the angle of the mouth at 2. A flap, formed of the integuments of the neck, having been dissected off, is shown as being partially rotated on its base, and about to be carried up to cover the deficiency. The wound on the neck may either be approximated at its edges, or left to heal by the second intention. *After Bourgery and Jacob.*

Plate 21.

Fig. 1.

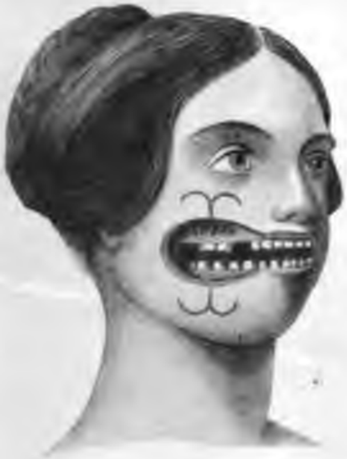


Fig. 2.

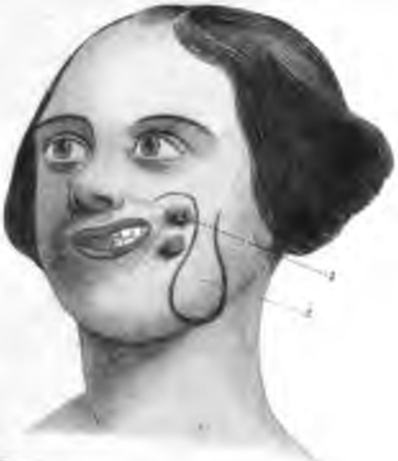


Fig. 3.

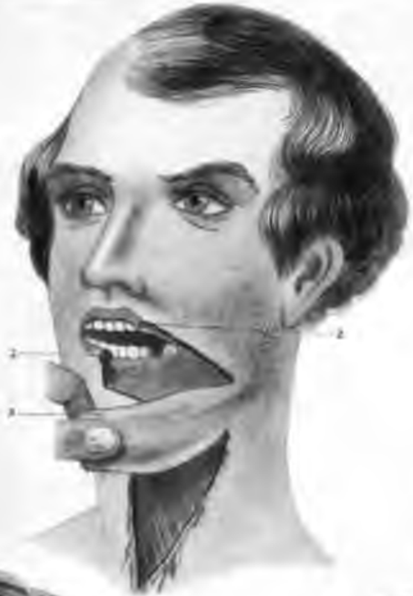


Fig. 4.

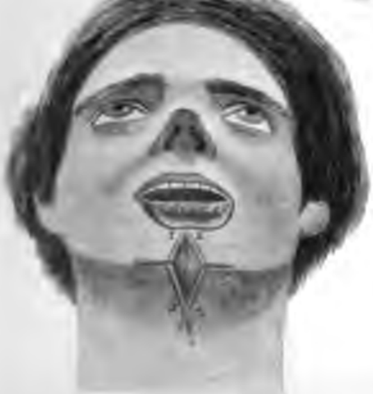
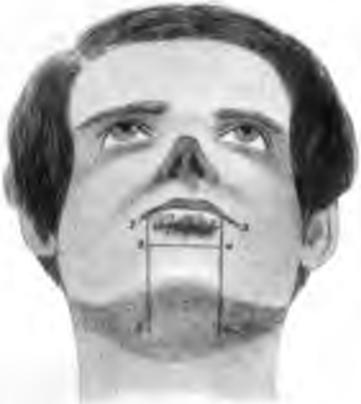


Fig. 5.



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hyoides. These incisions formed a square flap, which was dissected off from the chin from above downward, Plate XXI. Fig. 4. The diseased portion being then cut off by a horizontal incision, the head was slightly flexed and the flap drawn up to the level of the angles of the mouth, where it was maintained by several stitches placed in the line of the vertical incisions.

When the preservation of a portion of the mucous membrane can be accomplished, it will add much to the natural appearance of the new lip.

Operation of Malgaigne.—This surgeon removed all the diseased structure either by a V incision or by two vertical incisions, which, starting on each side of the cancer, reach to the chin, and are there united by a horizontal cut, as in the upper incision of the operation of Chopart.

In the V incision, in consequence of the triangular wound, it is necessary to prolong the angle of the mouth on each side by a transverse cut, and to dissect the flaps so as to give them a triangular shape. Then, drawing them forward, and uniting their vertical edges by sutures upon the median line, it only remains to close the horizontal incision, in order to obtain a proper fullness for the lip.

In the two vertical incisions, the gap being square, it is necessary to make two horizontal cuts, by which the angles of the mouth may be elongated. Then, making another horizontal cut parallel to the base of the jaw, detach the two square flaps thus formed, and unite them on the vertical or central line, as well as on the horizontal incisions, when the cheeks will be made to contribute to a lip which contains a portion of the orbicularis, as well as the lining membrane of the mouth.*

Operation of Hamilton, of Buffalo.†—A lad, seven years old, having lost his lower lip and corresponding portion of the jaw from salivation, mastication became difficult, and the saliva poured upon his chin so as to induce excoriation of the face and neck and wet his clothing. To remedy this, Hamilton, under the impression "that by attaching the skin directly to the periosteum, its displacement by cicatrization and contraction would be prevented," operated as follows:—

First Operation.—The upper edge of the skin corresponding to the lower lip being first abraded to the extent of a quarter of an inch each way, from the central line, a perpendicular cut of one inch was made from either end of this horizontal abrasion. Then, starting from the lower end of each perpendicular cut, an incision was made outward and downward to the left, and outward and downward to the right, to the extent of one inch and a half.

The two lateral flaps, thus formed, being next dissected from the jaw and slid upward, were united by sutures above the central piece, and their inferior edges also stitched to the upper and abraded edge of the central piece, so that by leaving the central piece attached to the jaw and uniting the lateral flaps above it, the new lip thus formed would be prevented from being drawn down again by the contraction of the wound below. This proved, to some extent, successful, though the new lip, in process of time, shrunk to such an extent as to become insufficient, and rendered another operation necessary in order to increase the depth of the lower lip and enable it more effectually to retain the saliva.

Second Operation.—A single incision being made just under the chin, was extended along the base of the jaw about three inches from side to side, and all the integuments between this horizontal cut and the upper edge of the lower lip being raised from the bone, the entire mass was slid up until its lower edge corresponded with a line just below the upper border of the jaw, when the edge of the flap was made fast to the periosteum by several points of the interrupted suture, the wound below being healed by granulation. The result was, that no disposition was shown by the flap to draw downward as the wound cicatrized, but, on the contrary, the skin from under the chin and neck was somewhat drawn upward.

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* Malgaigne, Op. Surg., p. 340, Philad. edit.

† South. Med. and Surg. Journ., vol. vii. p. 742.

Remarks.—This operation presents evidence of considerable ingenuity, and was rewarded by success, as the lad obtained sufficient lower lip to cover the gums and a part of the bodies of a set of artificial teeth.

The preservation of the periosteum, in such cases, is stated by Hamilton to have originated in his observation of the capacity of the periosteum to form new skin, a suggestion which may be doubted with our present knowledge of elective cell action. Periosteum has never been known to form anything but bone or fibro-ligamentous tissue.

§ 6.—Genioplasty.

The application of the principles of plastic surgery to the restoration of deficiencies in the cheeks must, like the operations already spoken of, depend upon the peculiarities of the case. The two instances hereafter stated may, therefore, suffice as illustrations of this class of operations.

In a patient of Mott, of New York—see Plate XXI. Fig. 2—in addition to the loss of substance in the cheek consequent on sphacelus during an attack of typhus fever, there was also some false anchylosis of the jaw. To remedy this, he operated as follows:—

Mott's Operation.—An incision, commencing a little within the upper angle of the mouth, was carried around the outer margin of the cicatrix to a little within the lower angle of the under lip, so as to remove all the newly-formed tissues within it. Then, after overcoming the anchylosis, the lips were brought together at the angle of the mouth by a suture, and a portion of integument, sufficiently large and of a corresponding shape to replace the portion removed, was taken from the side of the jaw and neck, Plate XXI. Fig. 2. This portion, being turned into the space it was intended to fill, left a tongue three-quarters of an inch in breadth connected with the adjacent parts, and sufficient for all the purposes of circulation. The edges being then accurately adjusted by means of the interrupted suture and adhesive strips, and the lower wound drawn together as much as possible by adhesive plaster, the whole was covered with lint, a compress, and bandage. On the eighth day, adhesion appeared to have taken place at every point, when three of the stitches were removed, and in about one month the patient went home cured.*

Dieffenbach, in cases where the sides of the ulcer could be at all approximated by drawing upon the substance of the cheek, freshened the edges of the opening and united them by sutures; then, in order to obviate the danger of separation of the wound when the sutures were withdrawn, or when the cicatrix was stretched, he made an incision across the base of the flap at the side where the parts were most tense, and left this wound to heal by granulation.

Operation of Mütter, of Philadelphia.†—In order to relieve a shocking deformity of the face, resulting from the sloughing consequent on profuse salivation, Mütter operated as follows: Having first extracted the useless teeth of the upper jaw, which would have prevented the proper adjustment of the flaps, or induced their ulceration, and freshened the edges of the ulcer, he detached the integuments from the side of the jaw, in order to permit some approximation of the wound. Two incisions above and below the ulcer were then made so as to form four flaps, Plate XXI. Fig. 1, and these were united to each other in the line of the teeth, as far forward as the angle of the mouth. The edges of the remaining ulcer, being partly approximated by the hare-lip suture, were subsequently caused to cicatrize under the use of the nitrate of silver. The result was entirely satisfactory.*

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* Am. Journ. Med. Sciences, vol. ix. p. 47, 1831.

† Ibid. vol. xx. p. 342.

§ 7.—Removal of Tumors from the Cheeks.

From diseases of the buccal glands and other causes, it sometimes becomes necessary to remove tumors from the substance of the cheeks. No rules need here be given, in reference to elliptical or such special incisions as the case may call for, except two of a general kind: 1st, to make them as much as possible in the line of the zygomatici or levatores anguli oris muscles, so as to conceal the cicatrix by bringing it into the direction of the natural folds of the cheek; and 2d, if the tumor is far back, or toward the angle of the jaw, to guard against injury of the duct of Steno.

§ 8.—Salivary Fistula.

As the position and general anatomy of the duct of Steno have been already given, (page 151,) it is only necessary at present to mention the operations resorted to in cases where, from wound or ulceration, this duct has been opened and the saliva flows out upon the cheek, and thus forms a **Salivary Fistula.** Various plans have been suggested for the relief of this defect, but the object of all of them is the same, to wit: to close the orifice on the external side of the cheek, and keep open that upon its inside. The nearer the external opening can be made to approach the character of a simple incised wound, the greater will be the chance of its closure; and the following operation of Horner, by reducing the parts to this condition, has, both in his hands and my own, been followed by perfect success. In two patients on whom I have operated, the cure was readily accomplished by this method, the external parts healing by the first intention.

Operation of Horner, of Philadelphia.—The patient being seated with the head well supported by an assistant, the operator introduces a strong broad wooden spatula within the cheek of the affected side, where it should be firmly held by the same assistant. The wound being then slightly elongated by incising its sides in the line of the zygomaticus major muscle, a round punch, like that employed by the saddlers, should be placed over the fistulous orifice, care being taken to avoid the anterior edge of the masseter muscle. Then, on pressing the punch firmly against the spatula within the mouth, a piece of the entire thickness of the cheek will be removed by the instrument, and a fresh opening made directly into the mouth, when the external wound, being accurately closed by sutures and adhesive strips, will usually heal kindly, and the internal opening be found to give free vent to the saliva. The punch must have a keen edge, and the cheek be well supported by the spatula, in order to obtain a clean cut, Plate XXIV. Fig. 3.

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* Lecture on the Operations in Surgery, by Robert Liston; with numerous additions by Thomas D. Mütter, M.D. Philad. edit. p. 244.

§ 9.—Division of the Masseter Muscle for Immobility of the Lower Jaw, (False Anchylosis.)

This disease, which has been charged with being peculiarly an American one, owing to its having frequently ensued upon the free salivation at one time so common in certain sections of the United States, was first treated of as a distinct affection by Mott, of New York.* The operation for its relief is especially demanded in those cases where the anchylosis is dependent on cicatrization or contraction of the soft parts, and was first performed by J. W. Schmidt, of New York, Oct. 1841.† Subsequently, Carnochan, of the same city, published an account of a similar operation performed by him in 1840; but, as his publication was after that of Schmidt, the latter has generally received the credit of priority. In Schmidt's case, a young lady, in consequence of rigidity of one of the masseter muscles, caused by an extensively ulcerated throat from which she suffered when a child, had not been able for more than twelve years to open her mouth so that the end of the little finger could be inserted. After dilatation and similar means had failed, Schmidt operated as follows:—

Operation of Schmidt, of New York.—A narrow bistoury being passed through the mucous membrane of the mouth immediately in front of the anterior edge of the masseter muscle, on a line with the alveolar process of the lower jaw, the integuments of the cheek were raised from the muscle with one hand, while with the other the bistoury was passed over the masseter muscles between it and the integuments, but without cutting through the latter, when the muscle being completely divided to the bone, the mouth was immediately opened by a lever. Considerable hemorrhage followed, and some extravasation into the cellular substance of the cheek, but this soon subsided, and the case succeeded perfectly. To prevent the union and subsequent contraction of the muscle to its former condition, pieces of soft wood of a wedge-shape were kept in the mouth during the night, and occasionally during the day.‡

The danger likely to ensue from inattention to the anatomical relations of this region will be readily foreseen by every anatomist, or may be recognized by reference to Plate XXIV. Figs. 1, 2, where the position of the vessels and of the salivary duct is shown after the removal of the parotid gland.

Mott's Operation.—In seventeen cases of false anchylosis of the jaw, reported by Mott,§ forcible dilatation was practiced after, or in some instances without, division of the contracted tissues. To overcome the contraction and expand the jaws, Mott employed only a screw and lever, similar to that of Heister, as depicted in the *Armamentarium Chirurgicum* of Scultetus, and also in the *Surgery* of John Bell. The levers, being introduced between the teeth, are gradually expanded by turning the screw.

An instrument suggested, and frequently employed by Rhea Barton, Plate XXIII. Fig. 1, will also be found to furnish an excellent means of relieving anchylosis. Its advantages over the lever of Heister consist in the breadth of its plates, in their being covered by a layer of caoutchouc, and in their affording a better basis for the teeth, in consequence of which the latter are less liable to injury.

Remarks.—From personal experience, and from an examination of the recent articles published by American surgeons, I am satisfied that this complaint is comparatively common in this country, and also that it is frequently very difficult to eradicate. When the result of extended sloughing, or when of many months' standing, the prognosis should be very guarded, as it is not uncommon to find more or less reproduction of the stiffness after the dilating means are discontinued. In more recent cases—say of six months' duration—the prognosis will be more favorable. As the immobility, even when due to the muscles in the first instance, generally results in more or less adhesion of the condyles and glenoid cavities, it should be remembered that it is more important to preserve slight and constant motion of the jaw, so as to favor the synovial secretion, than to rely upon great dilatation at an interval of several days. Frictions with anodyne liniments, or the cold douche, applied by pouring water from a small pitcher upon the indurated region, will do much toward facilitating the cure, as they will promote the absorption of effused lymph, and favor an increased circulation through the muscles of the part. My experience, therefore, leads me to place more confidence in gradual dilatation, friction, etc., as just stated, than on subcutaneous or other incisions, as I have found the rigidity very apt to return to a greater or less extent, as cicatrization goes on, in consequence of the uniting medium being less extensible than that consequent on the division of a tendon.

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* Mott's Velpeau's Operative Surgery, vol. iii. p. 1139.

† Amer. Journ. of Med. Sciences, p. 516, Oct. 1842.

‡ Ibid. loc. cit.

§ Mott's Velpeau, loc. cit.

CHAPTER VII.

OPERATIONS PRACTICED WITHIN THE MOUTH.

THE operations that may be required in this region are those dependent on diseases of the tongue, tonsils, and palate.

SECTION I.

ANATOMY.

The description of the anatomical relations of the parts within the mouth may at present be confined to such portions of that cavity as are found within the line of the teeth, and require therefore but brief notice.

The Tongue, being composed in a great measure of the genio-hyo-glossus, hyo-glossus, and lingualis muscles, which connect it both with the os hyoides and the lower jaw, is covered by a mucous membrane the reflection of which to the floor of the mouth constitutes the Frænum Linguæ. The general arrangement of the fibres of the genio-hyo-glossus, and their expansion from their origin into the bulk of the tongue, may be understood by referring to Plate XXII. Fig. 2.

The Lingual artery is the main source of the blood supplied to the tongue. Coming from the external carotid, this artery penetrates the hyo-glossus muscle just above the os hyoides, and of course lies too deep for any operation upon this organ except its extirpation, Plate XXII. Fig. 2. The sublingual branch of this vessel, being more superficial, passes forward just above the sublingual gland, near the median line of the tongue, between the mylo-hyoid and genio-hyo-glossus muscles, to supply the floor of the mouth and its lining membrane. Except in an attempt to extirpate the sublingual gland, it is not much exposed to injury in operations upon this part. The ranine artery and its accompanying vein are the continuation of the lingual artery, and advance on each side of the median line of the tongue directly to its tip, where there is an anastomosis of the vessels of each side. The ranine veins are especially superficial, and may be seen just beneath the mucous membrane on turning up the tip of the tongue. They can, therefore, be readily injured, and may give rise to trouble, especially in children. The hypo-glossal nerve is shown in Plate XXII. Fig. 2, and requires no further reference, as it is not proposed to treat of the various wild operations that have been recommended for the cure of stammering.

The Glands of the mouth at present demanding notice are the sublingual, submaxillary, and the tonsil. The Sublingual gland, being only covered by the mucous membrane of the mouth, may be readily seen on turning up the tip of the tongue. Its duct or ducts open into the mouth on either side of the frænum below the tongue. The duct of the Submaxillary gland—Plate XXIV. Fig. 1—terminates by a small projecting orifice on the anterior margin of the frænum. The obstruction of this orifice gives rise to the disease termed **Ranula,** and consists in an accumulation of saliva within the duct, which, by distending the latter, or by forming cysts, creates a tumor. The saliva also sometimes deposits sabulous matter, and gives rise to concretions which are usually situated in the duct itself.

The Tonsil glands—Plate XXII. Fig. 1—in a healthy condition, are six or eight lines long, four or five wide,* and about three thick. They are situated within and between the half arches of the palate, and concur in forming the isthmus of the fauces. Immediately beneath or outside of the tonsils, or outside of the cavity—that is, toward the skin of the neck—lies the carotid artery, with the vessels found between the greater cornu of the os hyoides and the angle of the lower jaw. The proximity of these vessels should be remembered by the surgeon when using a bistoury upon these glands, as there is only a thickness of about three lines of tissue between them and the artery; and a case is reported by Béclard, in which the internal carotid was opened in an operation upon this region.†

The Palate is composed of two portions—the hard or bony structure, formed by the palate plates of the palate and superior maxillary bones, and the soft palate, which is composed of the mucous membrane and the muscles. The soft palate stretches across the back of the mouth from side to side, and obliquely downward and backward from the posterior margin of the hard palate. Its inferior free margin presents in its centre a projection (uvula) from a half to three-quarters of an inch long in the healthy state.

The Uvula—Plate XXII. Fig. 1—is composed of the azygos uvulæ muscle, which, arising from the posterior pointed termination of the middle palate suture, goes down into the uvula, but the point of the muscle stops half an inch short of its inferior extremity. The free end of the uvula is formed of loose cellular substance covered by mucous membrane, and in catarrhal inflammations often becomes edematous, swollen, and elongated, so as occasionally to require excision; but this excision should never be extended to the muscle, lest it impair the voice, and give it a nasal twang, from the patient's inability to close the orifice of the posterior nares.

From each side of the uvula proceed two crescentic doublings of the lining membrane, called the Half Arches, and designated as anterior and posterior. Within or beneath these folds lie the muscles of the part, some of which are important in connection with the operations on this region.

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* Horner's Anatomy, vol. i. p. 569.

† Blandin, Anat. Topographique.

The Constrictor Isthmii Faucium muscle is within the anterior half arch, arises from the soft palate near the base of the uvula, and is inserted in the side of the tongue near its root. It will close the opening between the mouth and pharynx.

The Palato-Pharyngeus muscle is within the duplicature forming the posterior half arch; it arises near the base of the uvula, and is inserted into the sides of the pharynx, and into the posterior margin of the thyroid cartilage. It draws the soft palate downward, or draws the pharynx upward.

The Tensor Palati muscle arises from the spinous process of the sphenoid bone; passes downward; winds around the hook of the internal pterygoid process, and is inserted into the soft palate near its middle, and into the posterior lunated edge of the palate bone. It spreads out or extends the palate.

The Levator Palati muscle arises from the point of the petrous bone, and passes downward to be inserted into the soft palate. It draws the soft palate upward.*

In the various operations for fissure of the palate, attention to the action of these muscles is essential to a successful result.†

SECTION II.

OPERATIONS UPON THE TONGUE.

The operations practiced on the tongue consist in such as are required for the relief of cancer, ranula, or hypertrophy in the tongue.

§ 1.—Cancer of the Tongue.

When the development of cancer in the tongue is of a limited extent, and shows itself as a circumscribed tumor, its removal may be accomplished either by the ligature or by excision.

Preliminary Measures.—In order to remove a cancerous tumor, or before attempting any operation upon the tongue, the surgeon will find it necessary to obtain entire control of the member, by inserting into its tip a tenaculum, a needle and ligature, or a pair of hooked forceps; but the former is preferable, both on account of its simplicity and efficiency. In order to employ it, direct the patient to protrude the tongue, and spear the tip of the organ by rapidly passing the point of the tenaculum through its structure, when its motions may be perfectly controlled without creating any very great suffering, and the hand of the assistant holding the instrument will then have this unruly member entirely in its power.

Ligatures, either of silk or of wire, may be resorted to for the removal of cancerous tumors when the disease is slight. When the silk ligature is employed, the base of the tumor should be transfixed by a needle armed with a double ligature, and then, on dividing this at its loop, each portion of the tumor may be strangulated by tying the ends firmly around its base. As the tissue to be constricted is extremely dense, it is requisite that the ligature should be drawn very firmly, in order perfectly to strangulate the portion included in the loop. Latterly the écraseur of Chassaignac has been applied for this purpose, and is useful where the position and shape of the

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* Horner's Anat., vol. i. p. 490, eighth edition.

† See Staphyloraphy.

PLATE XXII.

OPERATIONS PRACTICED ON THE TONGUE AND TONSILS.

Fig. 1. A front view of the anatomical relations of the parts about the Fauces, as shown with the Mouth widely open. 1. The dorsum of the tongue, as depressed within the teeth. 2, 3. The tonsils *in situ*. 4. The uvula. 5. The anterior half arch. 6. The posterior half arch, with the tonsil between it and 5. 7. The soft palate. *After Bernard and Huette.*

Fig. 2. A side view of a vertical section of the Mouth and Tongue, showing the anatomical relations of the Vessels and Nerves of the Tongue. 1. The lingual artery. 2. Its sublingual branch. The veins accompanying the arteries. 3. The hypo-glossal nerve. 4. The ranine vessels, as seen near the tip of the tongue. *After Bernard and Huette.*

Fig. 3. A front view of the Removal of the end of the Tongue, as practiced either for Cancer or Hypertrophy. 1, 2, 3. The lines of the V-shaped incision. 4. A pair of double-hooked tumor forceps, Plate I. Fig. 19, holding the portion to be extirpated, and controlling the tongue until the vessels are ligated. The incision should, therefore, not be carried entirely to 3, until the hemorrhage is checked and the flaps partially united by the application of the first suture. *After Bernard and Huette.*

Fig. 4. The operation of excising the tongue, as shown in Fig. 3. 1. Left hand grasping the flap of the right side. 2. The forceps holding the tip. 3. The right hand of the surgeon. *After Bourgery and Jacob.*

Fig. 5. The preceding operation as completed. 1, 2. The sutures approximating the two flaps. *After Bernard and Huette.*

Fig. 6. A three-quarter view of a Hypertrophied Tongue, (Lingua Vitula,) as it existed in Harris's patient prior to the operation. *After Harris.*

Fig. 7. A vertical section of the Mouth and Pharynx, to show the excision of the Tonsil by means of the probe-pointed curved bistoury and tumor-forceps. 1. The forceps holding the gland. 2. The bistoury in the act of excising it. *Modified from Bernard and Huette.*

Fig. 8. A similar view of the parts in the Throat, showing the amputation of the Tonsil by Physick's instrument. 1. The right tonsil, as excised and about to be removed in the instrument. 2. The Tonsilotome of Physick. *Modified from Bernard and Huette.*

Plate 22

Fig. 1.

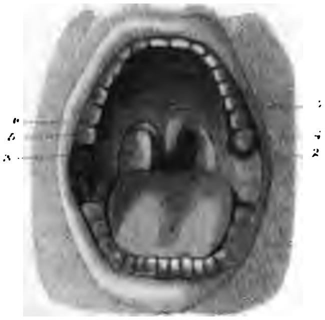


Fig. 2

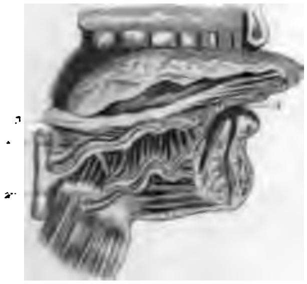


Fig. 5

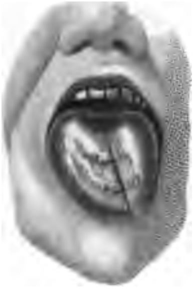


Fig. 6

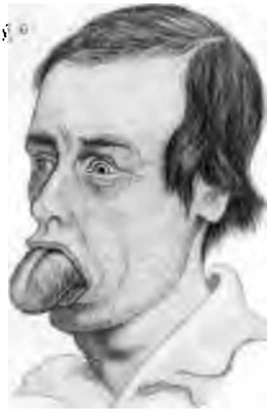


Fig. 3

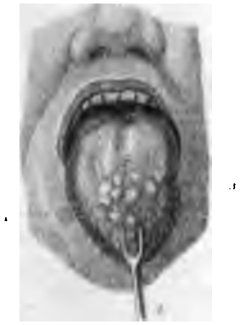
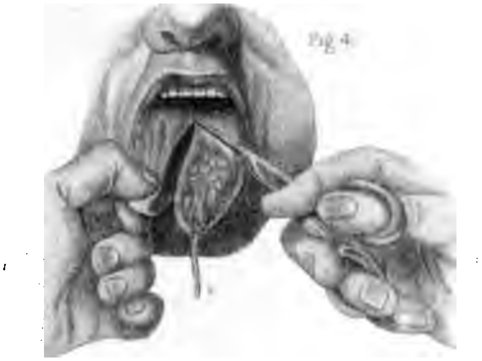
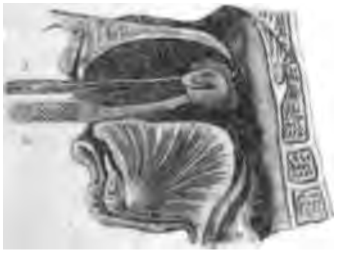
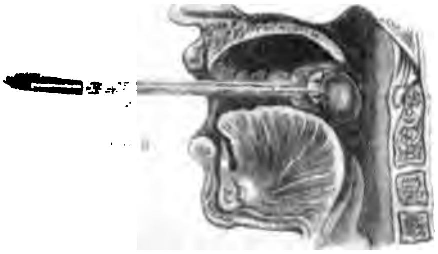


Fig. 4







tumor admits of its being constricted at its base before its extirpation by the écraseur.

The Double Canula and Wire Ligature.—When the wire ligature is employed, the double canula of Levret—Plate IV. Fig. 12—should be prepared, as directed for polypus of the nose; the motion of the tongue be perfectly controlled by the loop previously mentioned; a superficial circular incision made around the base of the tumor; a tenaculum passed through the diseased structure so as to elevate it from that portion of the organ in which it is deposited, and then the loop of the wire passed over the tenaculum and carried around the tumor in the incision first made. The wire being then drawn as firmly as possible, should be fastened to the wing of the canula, and the latter left, wrapped with linen or tinfoil, protruding at the angle of the mouth nearest to it until sloughing occurs, when the instrument may be removed.

Extirpation.—Excision of these tumors may be accomplished in this as in other cases, by elliptical incisions and dissection, the anterior cuts being made first, in order to prevent the hemorrhage from impairing vision. Subsequently, the wound should be closed by one or more stitches of the interrupted suture.

In more extended cases of disease, amputation or excision of the end of the tongue by a V-shaped incision, Plate XXII. Figs. 3, 4, as mentioned under Hypertrophy, may be required.

The tongue may also be removed by the écraseur without much hemorrhage; Choppin, of New Orleans, having successfully accomplished it with this instrument in fifteen minutes, in a case of cancer.*

§ 2.—Hypertrophy of the Tongue.

Under the name of **Lingua Vitula**, authors have described an enlargement of the body of the tongue, which sometimes has been so great as to require the excision of the enlarged portion in order to enable the patient to retract the tongue within the mouth. The operation of Harris, of Philadelphia, in 1830, which was the first performed in the United States, was of a marked character. His second operation, in May, 1835, in which I assisted him, was of a similar character, and sufficiently illustrates the ordinary proceeding in such cases.

Amputation of the Tongue by Harris, of Philadelphia.—The patient, aged nineteen, had the tongue enlarged at birth. A short time previous to the operation, it projected beyond the upper incisors three inches; its circumference was six inches, and its vertical thickness one inch and a half, plate XXII. Fig. 6, and filled up the jaws so completely that it was necessary to have his food cut into small pieces and introduced at the side of the mouth.

Operation.—The tongue being elevated, a strong ligature was passed through its tip, so as to control its movements. The under surface was then dissected from the floor of the mouth about three-fourths of an inch behind the anterior part of the jaw, and a strong straight bistoury introduced into the organ at the point where the dissection terminated, whence it was pushed through between the median line and the left ranine artery, and being drawn forward and laterally, was made to cut a flap, which terminated near the first bicuspid tooth. The left ranine artery being then secured with a ligature, the bistoury was again introduced in a corresponding position on the right side, and the opposite or right flap made in a similar manner. The artery of this side being now secured, and the central portion, or space intervening, divided by strong scissors, the incisions or flaps resembled the letter V, and being approximated by three interrupted sutures, made a pointed, well-formed tongue of the ordinary length. A year subsequently, the patient articulated distinctly, and was relieved of all deformity.*

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* New Orleans Medical News and Hospital Gazette, Feb. 1859.

Having had a favorable opportunity of witnessing this operation, I could not but notice the great advantage possessed by the operator from the use of the ligature in the tongue in controlling the motions of this organ; and as but one-half of the structure was incised at a time, the hemorrhage was readily controlled by the immediate application of the ligature to the artery. The flaps were then accurately adjusted by sutures without any difficulty.

In a previous case, June, 1829, the same surgeon applied a ligature to the enlarged portion, in order to cause it to slough off, but the irritation was so great that he was subsequently obliged to amputate the end of the tongue with a catlin. In this patient, the tongue protruded beyond the teeth four inches; its circumference was six inches and three-fourths, and its vertical thickness one inch and three-fourths.†

In a case, also congenital, operated on by H. S. Newman, of Pennsylvania, the enlargement was very great, the portion amputated measuring in length two inches and three-fourths, circumference seven inches and a half, thickness one inch and a half.‡ J. C. Warren, of Boston, Mussey, of Cincinnati, Wells, of Columbia, Hayward, of Boston, and Delaney, of the Navy, have also operated for the same complaint.

SECTION III.

OPERATIONS ON THE UVULA AND PHARYNX.

§ 1.—Excision of the Uvula.

When, in consequence of chronic inflammation, the mucous membrane of the uvula becomes infiltrated so as to resist the action of astringents, or when it and the azygos uvulæ muscle become relaxed, the end of the uvula is apt to fall upon the edge of the glottis, and produce a cough and irritation of the throat, accompanied by profuse expectoration, and such other natural symptoms of phthisis pulmonalis as have been mistaken, on a slight investigation, for those of this complaint. The effect of this state of the parts, and the mode of relief, were early suggested by Physick, of Philadelphia,§ who also reported a special instrument for the amputation of the elongated portion. Various other surgeons have since then proposed instruments which they deemed advantageous, and calculated to accomplish their object; but it will be found that a pair of dressing forceps to seize the point of the velum pendulum, and scissors or a bistoury to excise it, are all that are necessary.

Ordinary Operation.—Seize the end of the uvula by the forceps held in the left hand, depressing the tongue with the shaft of the instrument, or by a spoon in the hands of an assistant. Then, with a pair of scissors hooked at one end like those in Plate XXVI. Fig. 1, or curved on the flat, and held in the right hand, cut entirely through the elongated part, removing the piece in the grasp of the forceps. If the mucous membrane is not cut entirely through at the first clip, or if it escapes from the grasp of the forceps, the fragment will be apt to fall into the glottis and induce such violent coughing as will render its subsequent excision very difficult. Not more than three-eighths of an inch should be excised, and it is of great consequence to avoid amputating the muscle, as this will materially affect the voice, as before mentioned, and cause the individual to speak in a nasal tone. All that is essential in a primary operation is to cut off the glove-like end of the mucous membrane, and thus give vent to the serum that has elongated it. The subsequent cicatrization will generally accomplish the cure. If it does not, the probability is that the apparent elongation of the uvula will be due to a relaxed condition of the soft palate, and be relieved by stimulating applications, such as painting the parts occasionally with a strong solution of the nitrate of silver, or with the tincture of iodine or tincture of the chloride of iron.

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* Am. Journ. Med. Sciences, vol. xx. p. 15.

† Ibid. vol. vii. p. 17.

‡ Med. Recorder, vol. vii. p. 541.

§ Am. Journ. Med. Sciences, vol. i. p. 262, 1827.

Uvula scissors, constructed for this operation, are now generally kept by the cutlers.

After-Treatment.—Nothing more is requisite, after the operation, than to gargle the throat several times a day with cold water, and to guard against the use of hot, or highly seasoned, or salt food. Should there be any hemorrhage of consequence, touching the end of the stump with the nitrate of silver will generally arrest it.

§ 2.—Excision of the Tonsils.

Chronic inflammation of the tonsils, or repeated attacks of quinsy, sometimes cause such deposits of lymph in the parenchymatous structure of these glands as results in induration and permanent enlargement, or in the condition sometimes, though improperly, designated as scirrhus. The continuance of this enlargement being a constant source of irritation, such patients are liable to inflammation of the throat on the slightest change of temperature.

To relieve this sensibility, after the failure of other means, an operation for their removal may become necessary.

Operation of Physick.—In order to accomplish this object without any risk of hemorrhage, Physick proposed, and practiced for some years, the removal of these glands by sloughing, induced by strangulating them with the double canula and wire ligature before referred to.* But in consequence of the pain and inflammation which sometimes ensued, this operation has justly been supplanted by that of excision. Various instruments have been recommended by different surgeons for this purpose, and for a list of those suggested by surgeons in the United States, the reader is referred to the Bibliographical Index at the end of this part. At present, one of two instruments is most frequently resorted to in this country, viz., that of Physick, Plate XXVI. Fig. 3, and that of Fahnestock.

The instrument of Physick consists of a ring, which surrounds the part to be excised, and of a triangular-shaped knife, which, sliding in the ring, guillotines the gland.

Fahnestock's instrument is also formed of a ring, but his knife is of a circular shape, and excises the tonsil by drawing it toward the operator. This instrument has justly been objected to, by many who have employed it, from the difficulty of giving a good edge to a circular blade, and also from its tendency to cut by pulling upon the gland rather than by dividing it with the clean incision of a knife. That of Physick having none of these defects, and having its cutting edge of such a shape as will enable the surgeon to preserve or renew it himself, is preferred by others, and has much to recommend it. Velpeau prefers the instrument of Fahnestock, but has modified it to some extent; and I have lately seen a further modification by Charriere, in which the knife is only half a ring, and made to cut like a curved bistoury. This is, however, nothing new, a similarly shaped knife having been suggested and used by Rogers and Cox, of New York, nearly twenty years since.

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* See Polypi in the Nostril, p. 145.

Physick's Operation of Excision.—The patient being seated before a strong light, the head supported against the breast of an assistant, and the thumb of the latter made to press on the external parts just behind the angle of the jaw, so as to render the tonsil prominent in the throat, and force it from between the half arches, the surgeon should introduce the instrument flat upon the tongue, pass it rapidly back to the fauces, turn it on its side, so as to place the tonsil in its ring, transfix it with the needle attached to the instrument, and, pushing the knife backward, shave off all the portion included in the ring by a movement similar to that of a guillotine. Then removing the instrument, the excised portion will be brought out with it in less time than it takes to describe the steps of the operation, Plate XXII. Fig. 8.

Should this instrument not be at hand, a probe-pointed bistoury and dressing forceps may be made to answer by a skillful manipulator, Plate XXII. Fig. 7; but the proximity of the carotid artery to the outer wall of the pharynx at the seat of the tonsil, should induce the surgeon to be cautious, lest he open it by prolonging his incision to too great a depth.

After-Treatment.—The only after-treatment that is requisite is that referred to in excision of the uvula.

Remarks.—The simplicity of the operation of amputating the tonsil, as performed by the tonsilotome, is such that it is difficult, at the present time, to realize the anxiety and discussions of the surgeons of the period when amputation of the tonsil was first suggested. The fear of hemorrhage, which was so generally entertained at that period, is now seldom noticed, and out of very many cases upon which I have operated, I can only recall one in which there was sufficient bleeding to demand attention, and this yielded readily to the application of a strong solution of the nitrate of silver. When a tonsil has been indurated for many months, the effused lymph will cause such a constriction of the blood-vessels in the structure of the gland as will diminish their calibre, the limited space in which the tonsil is placed not permitting any marked distention of the structure, except in the line of the thickening of the gland. It may, however, prove useful to state that under no circumstance is it safe to attempt the excision of a portion of the tonsil when its structure is acutely inflamed, as the hemorrhage will then be very free.

CHAPTER VIII.

DISORDERS OF, AND OPERATIONS ON, THE UPPER JAW.

SECTION I.

ANATOMY OF THE PARTS CONCERNED.

THE **Superior Maxillary** bone articulates with the frontal, nasal, and unguiform bones: in front with the os frontis and nasal by its nasal process, by means of a firm regular suture; with the unguiform and ethmoid in the orbit of the eye, by simple apposition; and with the malar bone at its anterior external angle, by a firm suture. To the pterygoid process of the sphenoid bone at its posterior inferior portion; to its fellow of the opposite side; to the vomer in the middle line of the mouth, and to the palate bones in the same line posteriorly, it is also joined by more or less close adhesions.

The Inferior Maxilla forms the lower outline of the face, extending entirely around it from ear to ear. It articulates with the glenoid cavity of the temporal bone, just in advance of the external meatus of the ear, by means of its condyloid process. This process is a transverse cylindrical ridge directed inward and slightly backward, and springs from the ramus of the jaw by a narrow neck. The coronoid process is seated in advance of it, and has the temporal muscle inserted into its point. It is important to notice that both processes are apt to be much enlarged by tumors or malignant deposits, which sometimes require the resection of the jaw.

The Masseter Muscle, arising from the parts about the zygoma, is inserted into the base of the jaw at its angle. The Muscles forming the floor of the mouth are also attached along the base of the jaw on the inner side of the bone, and it is by this attachment that the tongue mainly maintains its position in advance of the glottis. When these attachments are divided, the tongue may be drawn in upon the glottis, and induce suffocation, unless artificial means are employed to prevent it, though it is not always the case, the connection of the sterno-hyoid muscles with the hyoid bone having a tendency to counteract the action of the styloid muscles, which are those that mainly induce it. The Carotid artery, in its connections with the parotid gland, is found near the angle of the jaw, but, by drawing the bone well forward and downward, this artery will be separated to some extent from the bone, in consequence of the posterior adhesions of the parotid.

SECTION II.

DISORDERS OF THE UPPER JAW.

§ 1.—Affections of the Antrum Highmorianum.

1. **Effusions into the Antrum.—Etiology.**—Effusions into the cavity of the antrum may be the result of a simple increase in the mucous secretion of the part, or they may ensue on a serous discharge from the lining mem-

PLATE XXIII.

INSTRUMENTS EMPLOYED ON THE JAWS AND EAR.

Fig. 1. A three-quarter view of Barton's Dilator for expanding the Jaws in cases of False Anchylosis. *Kolbè's pattern.*

Fig. 2. A view of the Dilator of Jno. Bell, of England. The screw causes the blades to separate. *After Bell.*

Fig. 3. A strong Scalpel, with a Raspatory at one end of the handle, applicable to all bone operations. *Kolbè's pattern.*

Figs. 4, 5. Strong double-edged curved Scalpels for the same purpose. *Kolbè's pattern.*

Figs. 6, 7. Strong Knives or Scrapers for excising Carious or other diseased Bones. *Charriere's pattern.*

Fig. 8. A pair of Hawk-bill Scissors, useful in dividing the middle palate suture in Resection of the Upper Jaw. The probe-pointed end is to be passed into the nostril, and the other blade made to cut from the mouth upward. This instrument is similar to that used by gardeners for lopping trees, and is the best kind of bone-nippers I ever employed. *Kolbè's pattern.*

Fig. 9. Horner's Triangular Vertical-Bladed Knife for dividing the transverse portion of the Palate in Resection of the Upper Jaw. *Kolbè's pattern.*

Fig. 10. Itard's Ear Speculum. *After Bernard and Huette.*

Fig. 11. Bonafond's Ear Speculum. " "

Fig. 12. Itard's Catheter for the Eustachian Tube. " "

Fig. 13. Blanchet's " " " " " "

Fig. 14. Dupuytren's Forceps for Aural Polypi. " "

Fig. 15. Fabrizj's Forceps for the removal of Foreign Bodies from the Ear. *After Bernard and Huette.*

Fig. 16. A Curette for the same purpose. " "

Fig. 17. Horner's Knife for perforating the Membrana Tympani. *Kolbè's pattern.*

Figs. 18, 19. Deleau's Instrument for perforating the Tympanum. In one the perforator is concealed, in the other protruded from its sheath. *Charriere's pattern.*

Fig. 20. Homer's Syringe for washing out either the external or middle Ear either with air or water. *Kolbè's pattern.*

Fig. 21. The Nozzle of Fig. 20 passed through a cork so as to plug up the external meatus when injecting the middle Ear. *From the instrument.*

Fig. 22. A Caoutchouc Bottle for washing out the Ear. *Charriere's pattern.*

Fig. 23. Horner's Portable Air-Chamber for Injecting the Ear. 1. The air-pump. 2. The tin chamber. 3. A cock which keeps the air in the chamber when charged. The opening of this tube being applied to the catheter and the cock turned, the current of air will pass as regulated ay the cock. *From the instrument.*

Plate 23

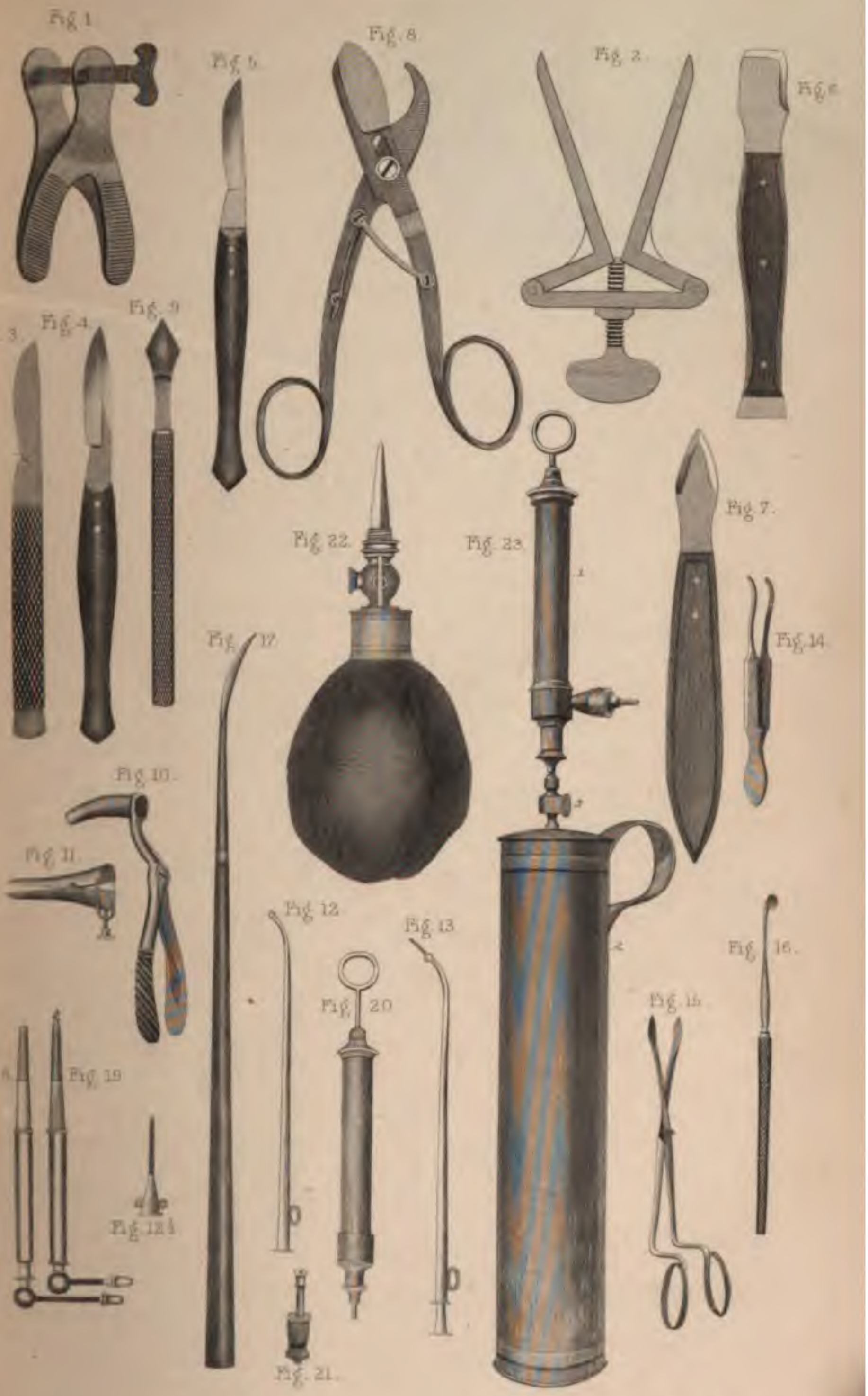

Fig. 1.
Fig. 5.
Fig. 8.
Fig. 2.
Fig. 6.
Fig. 3.
Fig. 4.
Fig. 9.
Fig. 7.
Fig. 22.
Fig. 23.
1
Fig. 17.
Fig. 14.
Fig. 10.
Fig. 11.
2
Fig. 12.
Fig. 13.
Fig. 16.
Fig. 20.
Fig. 15.
Fig. 18.
Fig. 19.
Fig. 12½
Fig. 21.

Bowen & Co.

brane, such as sometimes takes place from the Schneiderian or nasal membrane as the result of catarrh. These accumulations, owing to their being circumscribed, will often give rise to very distressing symptoms, one of the most painful of which is the neuralgic pain created by the pressure of the effused fluid upon the dental nerve, of which mention has just been made. Sometimes this fluid will continue to accumulate until, rising to the level of the orifice, it is evacuated through the nostril, and relief is obtained.

Treatment.—The treatment consists in the employment of such means as are applicable to irritated conditions of the mucous membranes generally—as warm applications; but if the accumulation of the fluid obstinately remains, it may be gotten rid of by puncturing the antrum, precisely as one would get rid of the pus in an abscess.

2. **Abscess of the Antrum.—Etiology.**—Abscess of the antrum is a complaint connected with inflammation of the lining membrane, and due to the same causes as would produce inflammation in the nose. Any irritation of the antrum, such as that created by exposure to cold; or the extraction of teeth under certain circumstances, as where the violence done at the moment of extraction produces fracture of the alveolar process; or where the prongs of the tooth, being unusually long, encroach upon the cavity of the antrum, may also develop an abscess of this cavity.

Symptoms.—From these circumstances, and from many other unexplained causes, inflammation of the lining membrane of the antrum is developed, from which an accumulation of pus results, which, having no exit, gradually increases in quantity and creates an abscess, thus producing severe suffering, until it has sufficiently filled the antrum and begins to escape into the nostril, when prompt relief follows, as in the evacuation of abscesses elsewhere. These symptoms will also be frequently aggravated by the violent neuralgia which is produced, as in the serous effusions into the antrum by pressure upon the dental nerve as it passes along the inferior wall of the antrum.

Treatment.—The treatment is first to evacuate the pus as soon as possible; but, as it is here necessary to act upon a bony structure, peculiar means become necessary in order to accomplish this. If the abscess has been caused by the extraction of a tooth, the pus may perhaps be evacuated by puncturing the floor of the antrum through the cavity in the alveolar process by some suitable instrument, such as a small trocar and canula, the trocar being withdrawn while the canula is left to keep the orifice in the mucous membrane open to permit the escape of the pus through it. After the entire evacuation of the matter, it will often be useful to inject the cavity of the antrum, through the canula, with tepid water, in order to wash it out thoroughly, as may be readily done by fitting the beak of a syringe to the mouth of the canula.

But sometimes an abscess of the antrum occurs which is not a result of the extraction of teeth, and, under these circumstances, it becomes necessary to make an opening through the sides or walls of the antrum, as may generally be done by turning the lip forcibly upward and puncturing the anterior and external walls of the superior maxillary bone by means of a strong trocar and canula, or by a sharp bistoury; this being a very simple operation, as the bones of the part are naturally thin, and, under the circumstances described, are not unfrequently rendered yet thinner by disease.

3. **Polypus of the Antrum.**—Polypus of the antrum may at times occur, though it is comparatively a rare disorder, unless found in connection with polypi of the nostril.

Treatment.—If the polypus is benignant, the treatment is to remove, by ligature or otherwise, the polypi in the nostril, if there be any, and to do likewise with so much of the polypus of the antrum as protrudes into the nostril, or can be reached from it; after which it will be necessary to act upon the diseased mass remaining in the antrum, by means of astringent and alterative injections, which are to be thrown into the nostril. But most generally polypi of the antrum are either primitively malignant in their character, or become the seat of malignant deposits, and then create a tumor of the antrum, which has a disposition to invade surrounding parts, the neighboring bones being encroached upon until they become diseased, and a peculiar condition results which requires extirpation of the superior maxillary bone entire, as hereafter described.

SECTION II.

RESECTION OF THE UPPER JAW BONE.

The development in the bones of the face of tumors of a malignant character, and their encroachment on the surrounding structures, has sometimes created such a condition as has rendered it desirable to remove either a portion or the entire structure of the bones which constitute the basis of this region. As the jaw bones are generally deemed to be essential to speech as well as mastication, it would appear, at first sight, as if their removal would necessarily impair the nutrition and also the usefulness of the patient, while their close proximity to large blood-vessels and important nerves indicates the necessity of great caution in any extended operations that might be practiced upon them. Such appears to have been the views formerly entertained by surgeons, respecting the practicability of resorting to resections of these bones entire; and we accordingly find that the earlier operations were either of a limited character, or only performed after every possible precaution had been taken to guard against hemorrhage, either by preparing cauterizing irons, or by ligating the main trunk of the carotids previous to the operation. The condition of patients who had suffered from extensive gunshot wounds of this region having shown, however, that a much greater amount of the face could be removed without loss of life than had been supposed, surgeons gradually extended their efforts to relieve the diseases of these parts, until they have at last succeeded in removing the entire upper jaw of each side, and taken away all the lower jaw from its articulations forward. Since the experiments of Ollier, in reference to the reproduction of bone when the periosteum alone remains, surgeons have taken advantage of the principle thus enunciated to apply it to many resections, and especially to those of the bones of the face, where it has proved most useful. In an account of the operations of Langenbeck, as translated by Holcomb, of New York,* several operations are reported, Langenbeck estimating highly the importance of denuding the bone of its thickened periosteum and retaining it for future reparation, *sub-periosteal* resection having been performed by him in two cases, though so recently that the results are not yet known. Transplanting the frontal periosteum, as included in the tegumentary flap for Rhinoplasty with loss of the ossa nasi, has also thus far been satisfactory. It is evident, therefore, that **osteoplastic** operations are likely to become a valuable addition to our present means of relieving the diseases and injuries of the bones, and the preservation of the periosteum should, therefore, be regarded as an important point in all operations on the bones generally, and especially in those of the face.

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* New York Monthly Review, April, 1860.

In reviewing the records of resection of the jaw, we find that Acoluthus, a surgeon of Breslau, first removed a portion of the upper jaw for a tumor, as early as 1693; that Jourdan also removed a part of the antrum Highmorianum for the relief of a tumor, in May, 1768, and that Dupuytren resected a considerable portion of the alveolar cavities of the bone, in 1819. These operations, though among the earliest of those recorded, did not reach the extent of a resection of either the entire body or even half of the bone; and it may, therefore, be justly said that the most extensive and daring resection of either of the bones of the jaws were first performed by American surgeons; that of Jameson, of Baltimore, upon the upper jaw, having been executed in 1820,* and that of Deaderick, of Kentucky,† upon the lower jaw, performed in 1810.

One of these operations—Deaderick's—was also performed nearly ten years prior to the operation of Dupuytren, while the other—Jameson's—was so near the same period as to leave no time for any communication of the event to this country. I have, therefore, no hesitation in claiming for American surgeons the credit of having been the first to illustrate the feasibility of these extensive resections.

The first resection practiced upon the bones constituting the upper jaw, was performed in the United States, for the removal of a tumor from the antrum, by Horatio G. Jameson, in November, 1820.‡ From an inspection of the drawing which accompanied this case, as well as from its history, it is evident that this resection embraced nearly the entire body of one superior maxilla, although the roof of the antrum, or floor of the orbit, which was not diseased, was allowed to remain.

The operation of resecting the superior maxillary bone of one side having been thus commenced, the resection was soon after—1824—carried yet further by David L. Rogers, of New York, who successfully removed nearly the entire upper jaw, that is, both superior maxillæ as far back as the posterior external portion adjacent to the pterygoid processes. Lizars, who was the earliest of the British surgeons that resorted to this resection, did not operate until 1827, and Gensoul, of France, whose subsequent proceedings have so intimately associated his name with the operation, did not attempt it until about the same year. Since 1827, the operation has been very frequently performed in the United States—Stevens, of New York, in 1840, having successfully extirpated the entire superior maxillary and malar bones with portions of the ethmoid and sphenoid of one side; R. D. Mussey, of Cincinnati, and John C. Warren, of Boston, having also successfully removed the upper jaw in 1842. A reference to the Bibliographical Index at the end of this part, will also show, that since this period many other American surgeons have been equally successful; so that this once doubtful operation may be now considered as permanently established. The result of the operation, as shown by an analysis of many of those performed in Europe since 1820, also indicates that an equally successful result has been obtained elsewhere, Ried§—Die Resectionem der Knochen—having collected thirty-five cases, in twenty-four of which the patients were reported as cured—meaning, probably, cured as to the operation, though not preserved from a return of the disease when the tumor was malignant.

As characteristic of the method usually pursued in this operation, the following one, performed by Warren, may be first referred to:—

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* Am. Med. Record, vol. iv. p. 222, 1820.

† Ibid., vol. vi. p. 516, 1823.

‡ Ibid , vol. iv. p. 222, 1820.

§ Philadelphia Med. Examiner, vol. ix. p. 595.

PLATE XXIV.

A VIEW OF THE ANATOMY OF THE SIDE OF THE FACE, AND OF SOME OF THE OPERATIONS PRACTICED ON IT.

Fig. 1. A side view of the Anatomy of the Face after the removal of the integuments. 1. The shape and position of the parotid gland. 2. The duct of Steno. 3. The sublingual gland. 4. The facial artery, at the point where it passes on to the face. 5. The facial vein. 6. The sterno-cleido-mastoid muscle. 7. The external jugular vein. 8. The zygomatic muscle. 9. Branches of the portio dura nerve emerging from the upper edge of the parotid; other branches are seen on the face. *After Bernard and Huette.*

Fig. 2. The same Section after the removal of the Parotid Gland. 1. The portio dura nerve at its exit from the stylo-mastoid foramen. 2. The duct of Steno divided transversely. 3. The external carotid artery when freed from the parotid. 4. The temporal artery. 5. The facial artery after removal of the sublingual gland. 6. The sterno-cleido muscle. 7. Main trunk of the external jugular vein. *After Bernard and Huette.*

Fig. 3. A three-quarter view of Horner's operation for the cure of Salivary Fistula. A wooden spatula supports the inside of the cheek; a slight longitudinal incision is made at the external fistulous orifice, and the hand of the surgeon is seen pressing the punch against the spatula so as to cut out a piece through the cheek. The external incision, being closed by a point of a suture, heals usually by the first intention, leaving the orifice, made by the punch, open in the mouth. *Drawn from Nature.*

Fig. 4. A view of the operation of Resection of the Upper Jaw, as practiced by the incision of Warren. 1, 2, 3. The flaps everted, and turned over the nose and eye so as to expose the bone. The left hand of the surgeon is holding, 4, the bone at the moment of disarticulation by the knife, 5, which is working at the pterygo-maxillary fissure. Velpeau's operation is nearly the same as that of Warren. *After Bernard and Huette.*

Fig. 5. Represents the completion of the operation, the union of the wound by the twisted suture, and the line of the cicatrix, which extends from the malar bone to the mouth near, but not at, the angle. *After Bernard and Huette.*

Fig. 6. A view of the termination of Gensoul's operation, showing the lines of his incision. 1, 2. The first incision across the tumor. 3, 4. The second incision. 1, 5. The third incision, forming flaps which are to be turned up and down upon the face. The sutures are seen as placed at the termination of the operation. *After Gensoul.*

Plate 24

Fig. 1

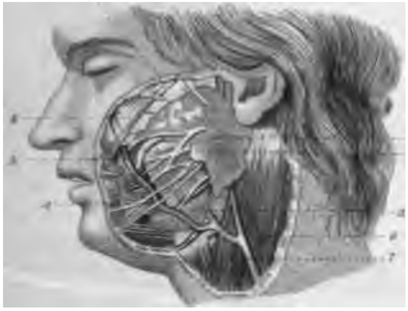


Fig. 2

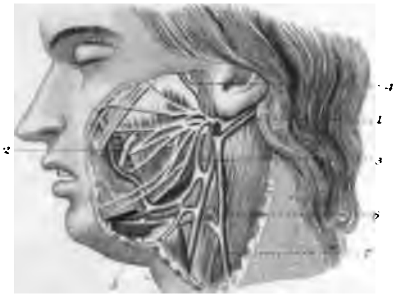


Fig. 3.

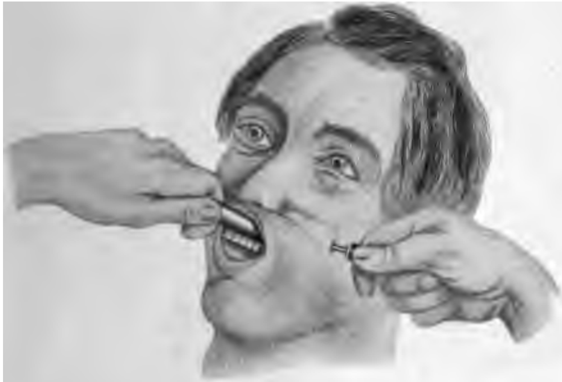


Fig. 4

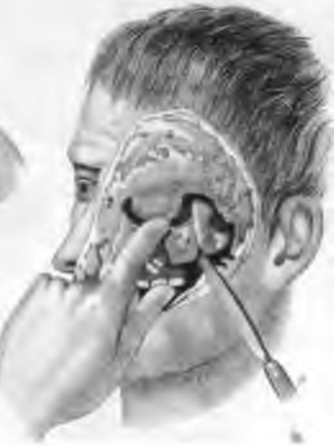


Fig. 5

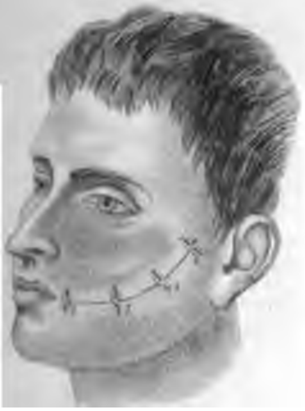
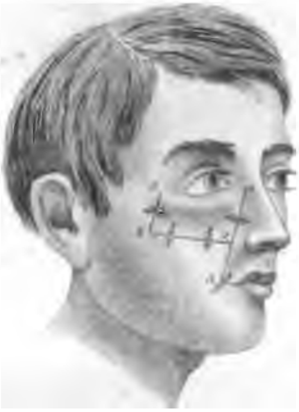


Fig. 6



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Operation of Warren.—The patient being seated with his head well supported, an incision was made through the cheek down to the bone, from the middle of the external edge of the left orbit, to the left angle of the mouth, and was followed by a copious gush of blood. The internal or nasal flap being then quickly dissected forward to the middle of the nose, the attachment of the cartilage of the left alæ of the nose was cut off, thus freeing the eyeball from the inferior part of the orbit, by dividing the inferior oblique muscle, the fascia of the eye, and the periosteum. The outer or lower flap was next rapidly dissected from the os malæ and superior maxilla, and around the latter bone as far as its union with the pterygoid process of the sphenoid; but the uniting space was not penetrated at this time, on account of the large pterygoid branch of the internal maxillary, which it would have been difficult to secure at this stage of the operation.

The two flaps being separated, the anterior extremity of the spheno-maxillary fissure was perforated, and the cutting forceps applied to the broadest part of the os malæ directly opposite to the perforation, by which it was smoothly divided in a few seconds.

The same instrument was then applied at the internal angle of the eye in an oblique direction from the lower edge of the orbit, to the lower termination of the os nasi, and the bone divided without difficulty.

In the mean time the blood flowed in torrents; one large artery required immediate ligation, but the bleeding of the others was controlled by compression of the carotid artery. The mouth of the patient filling with blood, frequent pauses were required to afford him an opportunity of ejecting it, and occasionally he was recruited with a little wine.

The most difficult part of the operation remained, that of dividing the sound from the diseased parts within the mouth, and separating the maxillary from the sphenoid and palate bones without injuring the latter, so as to leave the patient the whole of the soft palate, with the palatine plate of the os palati to support it.

In order to accomplish this without dissection, an incision was made through the mucous membrane of the hard palate, beginning at the edge of the palatine plate of the os palati, and extending forward to the front edge of the jaw, and then upward across the alveoli into the bone. To facilitate this incision, the central incisor within the left side was extracted so as to break the anterior part of the alveolus. Then, by a single stroke of the cutting forceps, the upper maxillary was separated from its fellow, and its palate plate cut through as far as its junction with the os palati. In order to separate the palatine plates of the maxillary and palate bones, the forefinger of the left hand was passed into the mouth to the last molar tooth, and its pulp turned forward to receive and support the cutting instruments, the flow of blood preventing anything being seen. A strong pointed knife was then stuck through the hard palate at the union of the maxillary and palate bones, so as to separate them, and also free the maxillary from the pterygoid process of the sphenoid, thus accomplishing the disunion of all the bones concerned.

Finally, the knife was passed externally behind the upper maxillary bone into the space between this and the pterygoid process, and, seizing the bone with the left hand by its orbitar and alveolar portions, it was, by a gradual movement, started from its situation, Plate XXIV. Fig. 4, and, aided by a few touches of the knife, freed from its remaining periosteal attachments. The hemorrhage was arrested by ligatures and lint. Eight weeks afterward the patient went home, and three months from that time continued well.*

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* Boston Med. and Surg. Journ., vol. xxvi. p. 9, 1842.

Horner, in a case of scirrhus of the antrum, succeeded in removing the whole of the upper jaw *without any external incision*, thus saving the patient the scar in the face. The removal of a considerable portion of the same bone was also successfully performed by Stevens, of New York, in 1823, and published in the *New York Journal of Medicine and Surgery* for 1849. The publication of this case having been delayed for several years, from motives of delicacy to the patient, who was widely known, Stevens did not receive that general credit to which his ingenuity entitled him, and I, therefore, now call attention to it. Horner was ignorant of Stevens's success at the time of his operation.

Removal of the Superior Maxillary Bone without any external Incision in the Cheek.—Horner having determined to avoid cutting through the cheek, as commonly practiced, the patient was seated in a chair, with his head well supported, and partially etherized. The assistant, supporting the patient's head, then raised the angle of the mouth on the left side, and held it widely open, while the upper lip and cheek were dissected from the superior maxilla as far back as possible, in a line parallel with the superior margin of the buccinator muscle. The two incisor teeth on the left side being then drawn, the corresponding alveoli were cut through in the middle line by a narrow saw, Plate V. Fig. 7, which worked its way from the mouth into the left nostril; then a pair of strong hawk-bill scissors, Plate XXIII. Fig. 8, such as are used by gardeners for lopping off twigs, took out the two vacated alveoli at a clip.

A thin, flat, well-tempered knife, with a strong, round handle, Plate XXIII. Fig. 5, was now struck through the roof of the mouth into the nose, at the junction of the palatine processes of the palate and superior maxillary bones, (posterior middle palate suture,) so as to cut forward and separate the maxillary bones from each other in the middle; when the narrow saw was again used to cut through the root of the nasal process of the maxillary bone, and strong scissors, curved on the flat, made to cut through the orbitar plate at its margin, the incision being carried back to the pterygoid process of the sphenoid, around and below the malar bone.

The base of the soft palate being then detached by a short triangular knife, Plate XXIII. Fig. 9, curved on the flat, so as to leave the soft palate attached to the palate bone, a few touches of the knife freed the remaining attachments.

The pterygoid process, malar bone, and the orbitar plate of the upper maxillary were not disturbed. The tumor, besides its bony connection, was also attached to the posterior part of the cheek, and to the external pterygoid muscle. The gouge and scissors, however, sufficed to remove every part that could be detected.

The bleeding was profuse, especially from what was believed to be the posterior palatine artery; but the vessel was readily secured by means of a ligature and Physick's needle, and a few other ligatures, with charpie, arrested the remainder of the hemorrhage. The drawing—Plate XXV. Fig. 1—shows the appearance of the mouth immediately after the removal of the bone, though representing it on the right instead of the left side of the face, in consequence of its being daguerreotyped, this peculiarity having been overlooked by the engraver. The amount of the jaw which was removed in this operation is accurately shown in Plate XXV. Fig. 2.

The additional time required for this mode of operating is probably fifteen or twenty minutes; but it saves the patient a scar for life.*

Three years afterward the patient presented no appearance of the return of the tumor; and his daguerreotype—Plate XXV. Fig. 3—shows the small amount of deformity.

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* Philadelphia Med. Examiner, No. 1, p. 16, 1850.

Stevens, of New York, in August, 1823, extirpated a fungus from the antrum maxillare, and removed a considerable portion of the bone also, without any external incision.

Operation of Stevens, of New York.—The second incisor and the last molar tooth but one being first extracted, the upper lip was dissected off from the jaw as high as the infra-orbitar foramen. The bone being then bored through by means of a trocar, which was carried backward and downward till it perforated the palatine membrane near the junction of the left os palati with the palatine process of the left superior maxilla, the palatine membrane was incised from this point to the external edge of the first left incisor tooth. The palatine process of the superior maxilla was next divided by a saw, with its teeth directed downward, passed through the route made by the trocar; and the bone, both above and below, between the socket of the last molar tooth and the perforations of the trocar, was also divided by a fine flexible saw, seven inches long, made of watch-spring, and having teeth only in its middle for the extent of three inches, the division being made in the direction of a curved line, which extended from the point where the trocar first entered to the alveolar cavity of the molar tooth extracted. No bad symptom followed, and in six months the opening in the antrum was completely closed.

The patient, seven years subsequently, was in perfect health.*

Mott, in an operation for a large polypus of the nose, was compelled to make a partial section of the upper jaw, by an incision through the integuments from below the internal canthus, down the side of the nose, and through the upper lip about three lines from the angle of the mouth. Then, dissecting back the two flaps thus made, he divided the necessary portion of the bone with a saw.†

Remarks.—It will be found to be a matter of some consequence, in these resections of the upper jaw, to leave the os unguis and the superior extremity of the nasal process of the superior maxillary bone untouched, in order to preserve the lachrymal sac from injury. When attention is not given to the preservation of this sac and its duct, the patient will be liable to a constant edematous condition of the lower lid, and suffer also from stillicidium lachrymarum. If the orbitar plate can also be left, it will diminish the deformity.

In tumors requiring the entire amputation of the jaw, the incision of Mott will be found to expose the bone freely, and may be advantageously resorted to; and in the case of a very large tumor, whose removal would be impracticable by the plan of Horner, this incision would probably open the parts sufficiently, and yet create a scar that would hardly be noticed.

SECTION IV.

RESECTION OF BOTH SUPERIOR MAXILLÆ.

The **Resection of both Superior Maxillary Bones**, which was first attempted by Rogers, of New York,‡ in 1824, was repeated by Heyfelder, in 1844, and again in January, 1850, both operations succeeding, though the disease

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* Velpeau's Surgical Anatomy. Appendix, by John W. Sterling, M.D., vol. ii. p. 518. New York, 1830.

† Velpeau's Surgery, by Mott, p. 907.

‡ Velpeau, Méd. Opérat., tome ii. p. 628.

PLATE XXV.

RESECTIONS OF THE UPPER AND LOWER JAW.

Fig. 1. A view of the inside of the Mouth, immediately after the removal of the left superior maxillary, as performed by Horner, without any external incision in the cheek. The soft palate is shown as preserved, but the engraving has reversed the side from which the bone was taken, making it appear as if performed on the right side. *After Nature.*

Fig. 2. A side view of the portion of bone removed from the mouth. *After Nature.*

Fig. 3. A likeness of the patient three years after the operation. *After Nature.*

Fig. 4. An outline of a Skull, showing the relative size and position of the Tumor in Barton's patient. *After Barton.*

Fig. 5. An outline of an Inferior Maxilla, showing the line of incision in the Jaw. *After Barton.*

Fig. 6. A front view of Barton's operation for Resection of the Lower Jaw without destroying its base, thus preserving the outline of the Face. In the original operation, the lower lip was divided vertically at its left angle, but this has not been done in the drawing, in consequence of its not being universally necessary. When the tumor permits it, the simple horizontal cut in the integuments, as shown in the figure, brings the cicatrix under the chin, where it is hardly perceptible. *After Nature.*

Fig. 7. A side view of Lisfranc's operation for Resection and Disarticulation of half of the Lower Jaw, at the moment of removal, the jaw being everted and drawn forward and downward in order to avoid any injury to the artery at this point. *After Bernard and Huette.*

Fig. 8. A front view of the Resection of the Chin or middle portion of the Inferior Maxilla, as practiced by Dupuytren. A vertical incision in the median line of the chin enables the operator to turn back two flaps (1, 2) and expose the bone, which may then be readily divided by Hey's saw, if it is desirable to cut from before backward, or by the chain-saw passed around the bone and made to cut from behind forward. The latter is preferable, in most instances.

After Bernard and Huette.

Plate 25

Fig. 1.

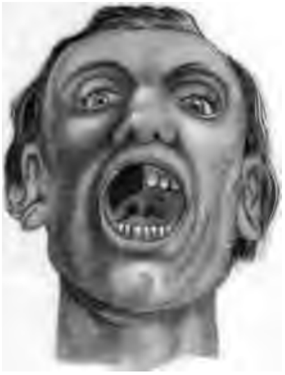


Fig. 2

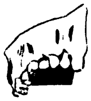


Fig. 3.

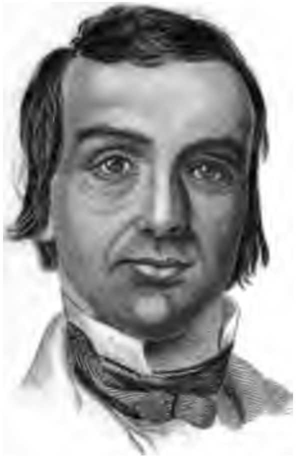


Fig. 6.

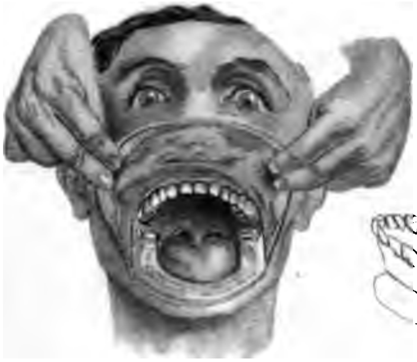


Fig. 4

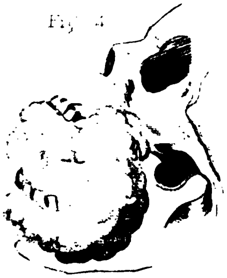


Fig. 5

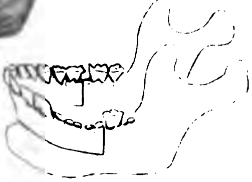


Fig. 7

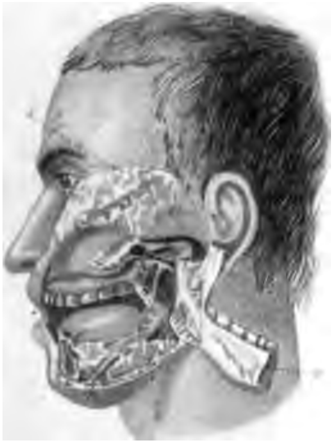
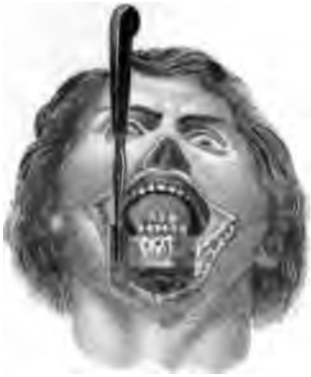


Fig. 8.



[illegible]

had reappeared in one case at the last account. It has also been performed, unsuccessfully, by Maisonneuve, of Paris, on a man sixty-nine years of age, who suffered from cancer of these bones, and, successfully, upon a young girl affected with necrosis from the vapor of phosphorus, or, as one account says, polypus. The first case was operated on as follows:—

Maisonneuve's Operation for Resection of both Superior Maxillæ.—A vertical incision being made in the middle line, so as to divide the nose from its root, and terminate in the upper lip, a transverse incision was made from the internal angle of the right to that of the left eye, leaving two large quadrilateral flaps, which were dissected along the edges of the orbit to the external angle on each side. These flaps being inverted, the disease was exposed. One end of a chain-saw being then passed by its needle through the spheno-maxillary fissure, and the other through the root of the nose, so as to traverse the os unguis of each side, the bones were detached laterally and superiorly, the velum palati freed transversely and posteriorly by a bistoury, and the entire mass of the bones detached by the help of Liston's forceps.*

Heyfelder's Operation.†—Both the superior maxillæ being involved in a malignant tumor, an operation for their removal was performed as follows:—

The patient being seated in a chair, with his head supported against the breast of an assistant, an incision was made on each side of the face, from the external angle of the eye to the labial commissure, and the included parts reflected upward toward the internal angles of the eyes, the nasal bones, and also toward the forehead, until the infra-orbital ridge was exposed. The chain-saw of Jeffrey being then passed through the spheno-maxillary fissures, the malar bones were divided, the maxillæ separated from the ossa nasi, and the vomer and the thinner bones cut with strong scissors, when the application of the chisel to the upper part of the tumor was sufficient to effect its separation by the employment of slight force. Very little blood was lost, torsion and compression sufficing to arrest the hemorrhage. Two hours afterward, the edges of the wounds, from the angles of the eyes to the corners of the mouth, being united by twenty-six points of the interrupted suture, cold lotions were applied; there was no reaction or swelling, and the patient could swallow water and broth. Four days subsequently, the wounds had nearly healed by the first intention, and in six weeks the patient was exhibited to the Medical Society of Erlachen. At this time there was no deformity of the features; a fissure, thirteen lines long and three lines wide, was seen along the median line in his mouth; the soft palate and uvula were in their natural place; deglutition was free; the nose had resumed its usual form and direction, and the face, which, before the operation, was like that of a monkey, again possessed a human expression; a firm and solid tissue replaced the extirpated parts.

Remarks.—In resection of the upper jaw, as in all other surgical operations, the circumstances of the case exert so great an influence on the decision of the means to be employed, that an estimate of their value must necessarily be only an approximation. Where the tumor will permit it, there is, however, no question that the operation of Horner, for the removal of the bone without an external incision, is the best for the patient, as it preserves the functions of the portio dura nerve, saves him a most unsightly scar, and, when the cheek can be freely dissected off from the surface of the tumor, exposes the part with considerable freedom. But if the development of the disease requires a more free opening of the integuments, in order to afford space for acting in the various steps of the disarticulation, then the simple curved incision from the outside of the malar bone to near the angle of the mouth, so as to avoid the main trunk of the portio dura, as practiced by Warren and Mussey, and subsequently by Velpeau, or the vertical cut of Mott, will probably answer better; but it is always advisable to make these incisions terminate near and not precisely at the angle of the lips, as the cicatrix, from its stiffness, is then less apt to interfere with the expansion or contraction of the mouth, and consequently with the expression of the face when the patient is engaged in conversation. In all external incisions, and especially those near the masseter muscle, the operator should bear in mind the position of the duct of Steno, and so arrange his incisions and dissections as to leave it uninjured in the lower flap of the integuments. Whenever the disease has not encroached upon the orbit, it is also desirable to leave the orbital plate for the support of the eyeball. But as this can seldom be told unless by opening the front of the antrum and removing the mass of the tumor, at the commencement of the operation, the proceeding will, in many cases, prove dangerous from the hemorrhage that it will induce.

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* New York Journ., vol. v. N. S. *from* Med. Gaz.

† *Med. Examiner, vol. ix. N. S. p. 595,* from Rev. Méd.-Chir. Paris.

Statistics of Resection of the Upper Jaw.—Resection of the superior maxilla has been twice performed by Jno. C. Warren, one patient being cured, and the other lost; the same surgeon has also performed partial resection many times with perfect success.* By a reference to the Bibliographical Index of this part, it will also be seen that the cases reported by Jameson, Rogers, Warren, Mussey, Stevens, Mott, and other American surgeons have often been followed by a successful result. From an analysis of these cases, we have the following facts:—

Of eighteen cases reported, ten were cured and eight died, or nearly three-fourths were cured, that is, the patients were doing well at periods varying from six weeks to five years after the operation. But, to prevent misapprehension in relation to the effects of this operation upon the disease, I would state that several of those above reported as cured, are so referred to by the operators solely in connection with the results of the operation, some of them being expressly mentioned as dying subsequently of the disease. In prognosticating the result of the operation, it should, therefore, be remembered that, though its happy termination is more marked than that of other great operations, (nearly three-fourths recovering,) yet the tendency to ultimate death from the disease is but slightly diminished by removing it from the point in which it was first apparent. According to the experience of every surgeon, it may be anticipated that in every instance of encephaloid tumor the disease will return, no matter how thoroughly the abnormal structure has been extirpated, but that in the fibrous or other non-malignant tumors there is no reason to apprehend a relapse. The results of Ried's examination of the history of this operation also shows that out of thirty-five cases treated in Europe, there were twenty-four cures.

SECTION V.

RESECTION OF THE INFERIOR MAXILLA.

The **Inferior Maxilla** may be resected either partially or entire, the former having been performed by Deaderick, of Rogersville, (now of Athens,) Tennessee, in Feb. 1810, and subsequently by Mott, of New York, in 1821, and the latter having been successfully performed by George M'Clellan, of Philadelphia, who, in 1823,* removed all the bone, anterior to its angles, and was the first surgeon who attempted so extended a resection of this portion of the face. Walther, of Bonn, and Græfe, of Berlin, have since then resected and also disarticulated the entire bone, and Carnochan, of New York, once repeated the operation in order to relieve a patient who was suffering from an extensive necrosis. Ackley, of Cleveland, Ohio, is also reported† to have succeeded, in July, 1850, in removing the bone *entire*, in a case of osteo-sarcoma, the patient being alive and in good health two years subsequently. The partial resection of the jaw has now been so often accomplished as to render it difficult to register all the cases.

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* Manuscript of Warren.

Whether the evils resulting from the loss of the entire lower jaw bone are not such as will forbid its repetition, is at present a question that experience has not settled. They should, however, be deliberately considered by every surgeon before attempting the operation, the difficulties of accomplishing the operation not being so great as the evils likely to ensue to the patient on its completion.

§ 1.—Resection of one Side of the Inferior Maxilla.

Operation of Deaderick.—An incision was commenced under the zygomatic process, and continued over the tumor—which almost entirely enveloped the left portion of the jaw, and occupied nearly the whole mouth—in the direction of the bone, to nearly an inch beyond the centre of the chin. A second incision was then begun about midway and at right angles with the first, extending a short distance down the neck. The integuments being now separated from their connection with the tumor, and the jaw sawed through near its angle, as well as at the centre of the chin, there was no difficulty in freeing it from its other attachments. The wound was then closed in the usual manner, and the boy had a speedy and happy recovery. Thirteen years subsequently, there was no connecting medium between the ends of the divided bone.‡ The description of the tumor shows it to have been enchondroma.

Remarks.—As the account of this operation was not published by Deaderick until nearly one year after Mott's operation, and as the latter surgeon had performed his operation before he heard of that of Deaderick, the credit of priority has been strongly urged, and by many accorded to the former gentleman. But as the case of Deaderick, though not published until 1823, contains the evidence of those who know it to have been performed in 1810, justice would seem to demand that Deaderick should obtain the renown which has been so frequently attached to those who only followed in his footsteps, especially as claims to the credit of originating the operation have been advanced in Europe both by the English and French surgeons. The decision of the priority of the operation of Deaderick is now generally received in the United States as correct, though there are yet some European surgeons who assign the credit of the first operation to Dupuytren in 1812. It is, however, but just to state, in connection with the varying claims of Mott and Deaderick to the originality of their operations, that the operation of Deaderick was a resection of a portion of the jaw, the ramus of the same side being left, while that of Mott was the resection of the entire half of the bone, and necessitated a disarticulation at the temporo-maxillary joint. Though the credit of the first resection of this bone therefore belongs to Deaderick, Mott was certainly the first American or European surgeon who, while resecting, also disarticulated half of the lower jaw.

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* Am. Med Review, vol. ii. p. 153, 1825. Also, Cooper's First Lines, p. 16, edited by Samuel M'Clellan. Philadelphia, 1830.

† N. Y. Journ. Med., vol. x. N. S. p. 288, 1853.

‡ Amer. Med. Recorder, vol. vi. p. 516. Philadelphia, 1823.

In the early operations performed by Mott, it was deemed essential to success to ligate the carotid artery a few days prior to removing the bone; but many cases, since operated on by others, as well as that of Deaderick, have proved that this step is only a complication of the proceeding; it is therefore now seldom resorted to.

Ordinary Operation for Resection and Disarticulation of Half of the Jaw.—The patient being seated on a chair, so that his feet will not touch the ground and enable him to tilt himself backward, and having his head supported by an assistant, make a horizontal incision over the tumor, from the angle to the symphysis, along the base of the inferior maxilla. A vertical cut over the symphysis, from the lip to the end of the first incision, will then free the flaps, which should be dissected back from the tumor, one being turned up on the cheek, and the other downward and backward. After sawing through the bone at the symphysis from without inward, shave off with a strong good scalpel all the soft parts on the inside, as far as the angle of the bone; then, drawing the bone outward and forward, use it as a lever, Plate XXV. Fig. 7; and, while its upper attachments are upon the stretch, insert behind the coronoid process, and just below the zygomatic arch, a bistoury, so as to detach the temporal muscle from its insertion. At the same time, while depressing the bone so as to dislocate the condyloid process, draw it forcibly forward so as to remove it from the artery, and divide the capsular ligament and pterygoid muscles, which will generally free the jaw entirely, when the wound may be closed with a few stitches and adhesive plaster.

Removal of the Middle of the Bone.—The patient being arranged as before, seize one angle of the mouth with the left hand, while an assistant does the same with the other, and, while drawing the lip tense, divide it immediately in its middle by a single vertical incision. The two flaps being then shaved off from the bone to the desired extent, let them be held by the aids, while the teeth at the points of division are extracted, when the bone may be cut through, either by Hey's or the chain saw, the latter cutting from behind forward, after being passed around the jaw by means of a needle. If it is desirable to divide the bone from before backward, a saw similar to that of Hey must be employed, Plate XXV. Fig. 8.

The point of the tongue being now held, either by a ligature introduced through it, or by means of a tenaculum, so as to prevent its being drawn back upon the pharynx, shave off the muscular attachments from the inside of the bone, and close the wound by sutures.

Should the portion of bone to be removed be the entire chin, it will, perhaps, be necessary to attach the tongue to the side of the cheek for a few days, by means of a suture, in order to prevent its retraction upon the glottis, lest this should induce suffocation.

Barton's Operation for Removal of Half the Jaw, by a Longitudinal Section, without destroying the base of the bone, so as to preserve the line of the face.—The patient had a tumor, (epulis,) which had taken entire possession of the mouth, forcing the tongue into the pharynx, and stretching the jaws widely apart. It also rose up outside the superior maxillary bone, Plate XXV. Fig. 6, protruding the lips, cheek, and neck on the left side.

Operation.—An incision, which commenced over the left angle of the lower jaw, being carried on a line with the under edge of the base around to near the edge of the masseter on the opposite side, through the integuments and muscles of the cheek and lip, so as to open the cavity of the mouth, the under lip was cut through vertically toward the left commissure of the mouth, so as to meet the first incision at a right angle, when the tumor, being thus exposed, was found to be adherent to the anterior and posterior surfaces of the bone. These adhesions being detached from the anterior face of the bone as high up as it was sound, Plate XXV. Fig. 6, the bone was cut through longitudinally with a small narrow saw from without inward, in a line parallel to the base of the jaw, and just below the maxillary canal, this section being extended as far back as the roots of the last molar tooth on the left, and the second molar on the right side. A vertical cut being then made through the alveoli between these teeth, so as to meet at a right angle the horizontal division of the bone, Plate XXV. Fig. 5, the portion thus insulated was found to contain the diseased mass, so that, after separating the attachments of the soft parts, the operator was enabled to take it away entire, Plate XXV. Fig. 6, leaving the base of the bone in a healthy state, except at one point on the surface, which was readily taken off with the nippers. No blood-vessels required the ligature, except the left facial and right coronary arteries. The flap being replaced, the vertical cut through the lip was closed by the hare-lip suture, and the remainder of the wound united by the interrupted suture and adhesive plaster. In a month the patient was well, the contour of the face was preserved, and he was able to masticate his food with the three remaining molars and their antagonists of the upper jaw.*

Resection of a Portion of the Lower Jaw, and Extirpation of the Inferior Maxillary Nerve, for the Cure of Neuralgia.—Operation of J. M. Warren, of Boston.—An incision being made from the sigmoid cavity of the temporal bone down to the edge of the jaw, the parotid gland was raised and turned to the outside, when the lower portion of the masseter muscle was dissected up, and a portion of the ramus removed by means of the trephine and chisel. The nerve being thus fully exposed, about half an inch of its main trunk was excised. The inferior maxillary artery was cut and tied, and there was also a slight discharge of saliva through the wound, from interference with the parotid.

§ 2.—Resection of the Inferior Maxilla Entire, or nearly so.

Operation of M'Clellan, of Philadelphia.†—The entire substance of the lower jaw, in front of its angles, being affected with osteo-sarcoma, and the tumor having extended in all directions and pushed the tongue back into the pharynx, so as to impede deglutition and respiration, M'Clellan operated as follows:—

Operation.—Making an incision through the integuments, from the left commissure of the lips obliquely downward and backward, he carried it over the anterior edge of the sterno-cleido-mastoid muscle, so as to command the internal carotid artery, if necessary. Having ascertained that the artery need not be touched, he next exposed the tumor by dissecting up the integuments, and, paying no attention to the small vessels, at once secured the facial artery, when the bleeding immediately ceased. After dissecting up the insertions of the masseter a little way behind the tumor, he divided the bone on each side with a metacarpal saw, turned the tumor out of the mouth, and dissected from the under surface of the tongue such portions of the submaxillary glands as were sound, when the remainder, and especially a portion of the left submaxillary, were removed with the tumor. Only three small arterial twigs required a ligature, and the wound was closed by sutures and adhesive plaster, the large cavity under the tongue being filled with lint, to support the skin. This patient recovered and lived some months subsequently, and the preparation is now the property of his son, J. H. B. M'Clellan, of Philadelphia, who has deposited it in the Museum of Pennsylvania College, Philadelphia.

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* Am. Journ. of Med. Sciences, vol. vii. p. 331, 1831.

† Cooper's First Lines, edited by Sam. M'Clellan, p. 16. Phila. 1850.

Remarks.—This operation was a very bold and successful one, but appears to have been generally overlooked by the profession, though its performance at so early a date should have given it a prominent position, especially as no surgeon had then attempted so extended a resection.

Resection of the Inferior Maxilla Entire.—Operation of Carnochan, of New York.—A patient in the Emigrants' Hospital having long suffered from a necrosis, which had loosened the teeth in the lower jaw, partially denuded the alveolar ridge, and caused great suffering and depression, it was decided to remove the inferior maxilla. The patient being seated, an incision was first made, commencing opposite the left condyle; then passing downward to the angle of the jaw, about two lines in front of the posterior border of the ramus, it was extended along the base of the jaw, and made to terminate by a slight curve on the mesial line, half an inch below the free margin of the lower lip. The flaps being dissected off, the bone was laid bare, and the tissues forming the floor of the mouth separated from their attachments, from the mesial line back as far as the angle of the jaw. The attachments of the buccinator being next divided, and the facial and sublingual arteries tied, the bone was found to be partially separated at the symphysis, and completely necrosed from this point to the inferior portions of the ramus, the latter being also diseased. A double ligature having now been passed through the anterior part of the tongue, and intrusted to an assistant in order to prevent its falling back upon the orifice of the larynx, the bone was broken at the symphysis and at the angle, and this portion readily removed; when, by pulling on the ramus, it was disarticulated and removed, after being freed from the soft tissues by the use of the knife and blunt-pointed scissors, without any injury to the internal maxillary artery. The same incision and dissection being practiced on the opposite side, the bone was disarticulated in a similar manner at this joint, also without injury to the blood-vessels, and the amount of blood lost was inconsiderable. Union of the wound occurred in forty-eight hours, and the patient afterward recovered, articulation being sufficiently distinct to render words intelligible, while his food was broken up by the pressure of the tongue against the roof of the mouth.

Remarks.—Although so important a portion of the general outline of the face and of the organs of mastication is necessarily removed in the resection of the lower jaw, the deformity which results from the operation is by no means such as might be anticipated. In the case of a gentleman, formerly an Interne of Lisfranc's at the hospital of La Pitié, who I saw in Paris in 1839, the deficiency was admirably concealed by his whiskers; and in the modification proposed by Barton, of Philadelphia, where a rim of the base of the jaw was left, it is very slight. In all cases, where the amount of the disorder will permit it, Barton's method of operating will be found to be the most advantageous; but it is essential to a successful result that as much as possible of the base of the bone below the orifice of the nutritious artery be preserved, in order to obviate the risks of necrosis from the want of circulation.

In reviewing the various methods of operating, it is therefore apparent that, as the object of all is the same, the modifications will be chiefly such as are demanded by the peculiarities of the case.

Statistics.—When we remember the character and extent of the parts involved in this operation, it must be admitted that the success attending resection of the lower jaw, and the relief afforded by it from a painful and loathsome complaint, is such as is highly creditable to the surgery of the nineteenth century.

Out of about one hundred and sixty cases collected from various sources by Velpeau, there have only been forty deaths, or one-fourth of the whole number operated on, a success which is very great when compared with the serious character of the operation.* By referring to the Bibliographical Index of this part, it will also be seen that the operation is one which has been frequently resorted to by American surgeons, the whole number of resections of this jaw there referred to, and doubtless reported as those of special interest, being forty-two. As many others have been performed within my knowledge, which have not been reported. The whole number of cases operated on, including those reported by Velpeau, now amounts to more than two hundred.

CHAPTER IX.

OPERATIONS ON THE PALATE.

THE occurrence of a fissure, either in the hard or soft palate, or in both, is most frequently the result of a congenital defect, and often coexistent with a similar fissure in the alveolar processes of the upper jaw as well as in the lip, as was mentioned when treating of the operation for hare-lip. In consequence of the effect of this fissure upon the tone of the voice, as well as upon the enunciation of words, it becomes desirable to attempt its closure by uniting the two halves, or by performing a plastic operation at as early a period as will be permitted by the patient, or rather so soon as the individual is willing and able to assist the operator in the efforts required for its execution. If the case is seen during infancy, the cure of the hare-lip will often diminish the size of the fissure in the palate, or materially aid the subsequent operation; but if both hare-lip and fissure of the palate are present in an adult, the operation must first be performed upon the lip, and then, if necessary, repeated upon the palate, the operation of staphyloraphy, or union of the fissure of the palate, being very much the same in principle as well as means of treatment as that resorted to for the relief of hare-lip.

SECTION I.

STAPHYLORAPHY.

The operation of refreshing the edges of a fissure in the palate, and then uniting them by a suture, was suggested by a French dentist, Le Monier, in 1764, and termed staphyloraphy—*σταφυλη*, the palate, and *ραφη*, suture.

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* Velpeau, Méd. Opératoire, vol. ii p. 620.

PLATE XXVI.

A VIEW OF THE INSTRUMENTS EMPLOYED IN OPERATIONS UPON THE THROAT, AND ESPECIALLY IN STAPHYLORAPHY.

Fig 1. Scissors for Excising the Uvula. *Kolbè's pattern.*

Fig. 2. Gibson's Spatula, to depress the Tongue. *Kolbè's pattern.*

Fig. 3. Physick's Tonsilotome for excising the Tonsil Gland. The ring surrounds the tonsil, the needle transfixes it, and the angular knife shaves it off. *Kolbè's pattern.*

Fig. 4. A long-handled double-edged Scalpel, for freshening the edges of the fissure in the operation of Staphyloraphy. *Kolbè's pattern.*

Fig. 5. Curved Scissors, with long handles, for the same purpose. *Kolbè's pattern.*

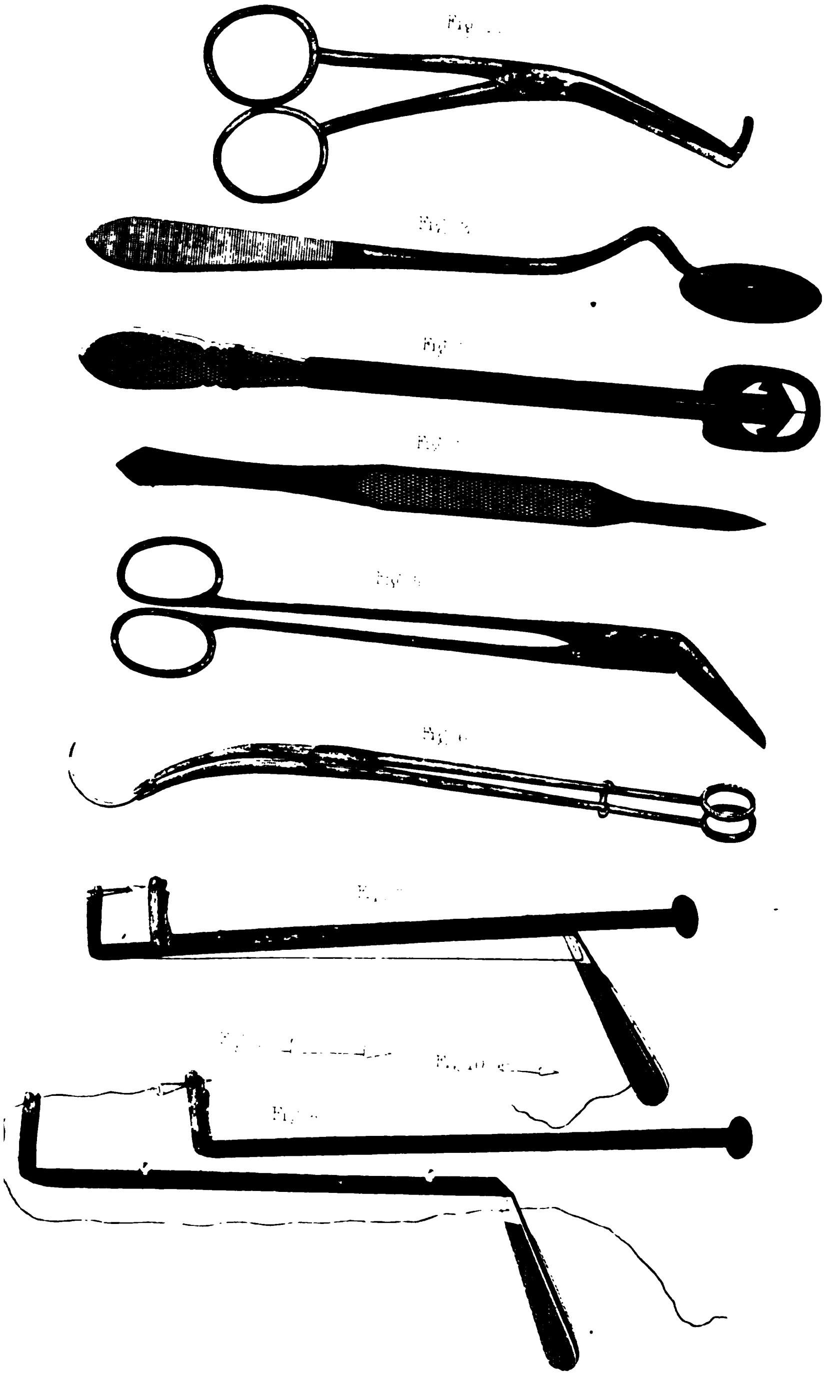
Fig. 6. Physick's Forceps, with long handles, and holding a small needle of the proper curve, to facilitate its passage through the side of the Uvula. This curve may be readily given to the ordinary curved needle, simply by pressure and gentle heat. The catch on the handle of the forceps enables the operator to free the needle in a moment, after transfixing the part, and again to seize its point with the same instrument, so as to draw it through the opposite side of the fissure. *Kolbè's pattern.*

Fig. 7. Gibson's Forceps for inserting the ligatures in Staphyloraphy, at the moment when the needle is passed through the palate. *Kolbè's pattern.*

Fig. 8. The same instrument drawing the ligature into its position. *Kolbè's pattern.*

Figs. 9, 10. Needles of different sizes, as adapted to Gibson's Forceps. The shoulder near the spear-point facilitates the grasp of the forceps, which close around it in consequence of a little split in the top of the first upright portion. *Kolbè's pattern.*

Plat. 26



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After being for a time forgotten, it was revived by Græfe, of Berlin, in 1817, but methodized and first published, with the rules for its performance, by Roux, of Paris, about 1819. In 1820, a nearly similar operation was invented and executed by John C. Warren, of Boston, he being, at the time, ignorant of the views or operations of the other surgeons. In many respects, the steps proposed by Warren and Roux corresponded, though the means suggested by Warren were the simplest. The operation of Roux being, however, generally regarded as the basis of the various modifications that have since perfected the proceeding, his plan may be first referred to.

Operation of Roux, of Paris.—Four different objects, which are to be attained in four different stages of the operation, have been laid down by Roux as likely to facilitate the surgeon's manipulation, and the success of the means employed.

1st. The paring off the edges of the fissure.

2d. The introduction of the ligatures at equal distances through its margins.

3d. The knotting of the ligatures and the approximation of the freshened sides of the fissure.

4th. The relief of any tension in the parts consequent on the suture.

Instruments.—The instruments proposed by Roux for accomplishing these objects are sufficiently complicated, consisting of three silk ligatures, made of two or three strands, and waxed; of six small, curved but flat needles, each end of the three ligatures receiving one needle; of a porte-aiguille or needle-holder; of dressing forceps; and of a probe-pointed bistoury, and curved scissors.

Operation.—The patient being seated before a strong light, with the head thrown back and supported against the chest of an assistant, the mouth is to be kept widely opened by means of a cork placed between the molar teeth. The surgeon, being placed in front, then seizes, with the forceps held in his left hand, the right lip of the fissure, and, with his right hand armed with the needle-holder, introduces the point of the needle from before backward behind the uvula, in order to traverse the flap from behind forward, Plate XXVII. Fig. 1, at three or four lines from the free edge of the fissure. The needle, being now thrust in as far as its head, is then to be freed from the needle-holder, and seized at its point by forceps, which draw it and the ligature through into the mouth. After resting a few seconds, the same manœuvre is practiced on the left half of the fissure with the other needle of the same ligature, the two ends of which are thus brought out into the mouth. In passing three ligatures, the operator should commence by the lowest, then pass the highest, and lastly apply the third in the middle of the fissure. Plate XXVII. Fig. 1 shows the ligatures as the last is being passed through the right side of the fissure.

The extremities of the ligatures, 3, 3, 4, 4, 5, 5, being brought outside the mouth, and their loop or central portion depressed toward the pharynx, the surgeon proceeds to

Freshen the Edges of the Fissure.—To accomplish this—Plate XXVII. Fig. 2—he should seize the lower end of the left margin with the forceps, 1, held in the left hand, and cut off the edge from behind forward with the probe-pointed bistoury, 2, or curved scissors, Plate XXVI. Fig. 5, held in the right hand, cutting from below upward, and prolonging the incision a little beyond the centre or angle of union of the two sides of the fissure. The other margin is then to be incised in the same manner by cutting a little beyond the angle of union, in order to free the flap.

In order to tie the ligatures, Roux commences by knotting the middle ligature—Plate XXVII. Fig. 1—with the fingers, and, after making a sim-

PLATE XXVII.

A FRONT VIEW OF THE OPERATION OF STAPHYLORAPHY.

Fig. 1. The operation as practiced by Roux. 1. The needle-holder (porte-aiguille) in the act of carrying the last ligature through the right side of the fissure. 2. Dressing forceps holding this margin. 3. The first ligature as placed, the ends being brought out through the angles of the mouth, and the loop being loose behind the palate. 4. The second ligature as introduced. 5. The third ligature. *After Bernard and Huette.*

Fig. 2. The three ligatures, 3, 4, 5, as before shown, being accurately placed, the surgeon proceeds to freshen the edges of the fissure with a probe-pointed bistoury, taking care not to cut the loops of the ligatures. 1. Forceps holding the free end of the palate. 2. The bistoury paring off a strip.

After Bernard and Huette.

Fig. 3. Operation of Warren. 1. The knife freshening the edge of the fissure from above downward. 2. The forceps steadying the margin so as to favor its regular incision. *Modified from Pancoast.*

Fig. 4. The introduction of the Suture by means of Physick's Forceps and a curved needle. 1. Physick's forceps introducing the needle. 2. Dressing forceps seizing its point at the moment when it is liberated from the instrument of Physick. 3, 4, 5. Position of the sutures. They should all be introduced at equal distances and as nearly parallel as possible. *After Pancoast.*

Fig. 5. The operation of Staphyloplasty, as practiced by Dieffenbach. 1, 2, 3. The sutures as tied, and closing the fissure. 4, 5. The two longitudinal incisions made on each side of the soft palate, so as to remove the strain from the line of union. *After Bernard and Huette.*

Plate 27

Fig 1

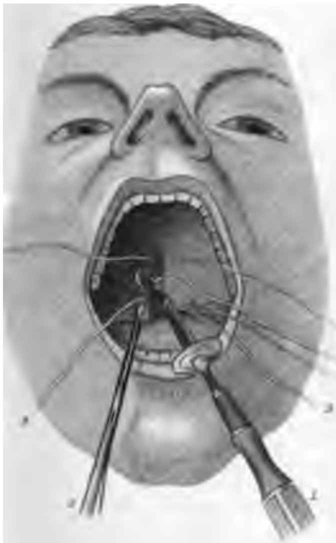


Fig 2

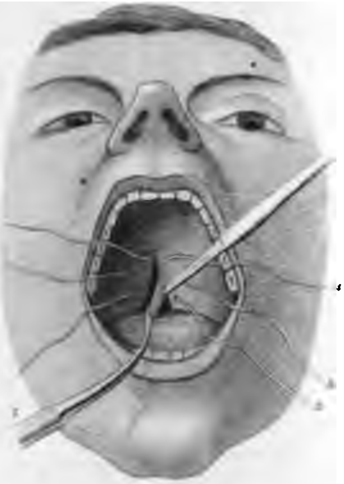


Fig 3

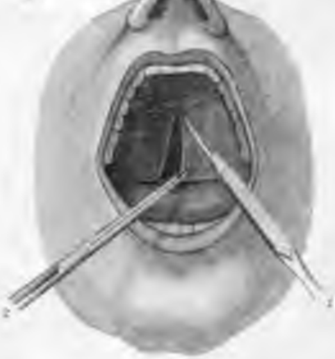


Fig 4

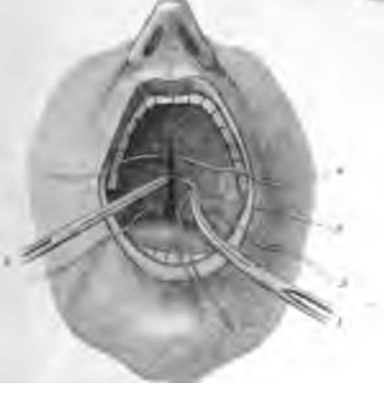
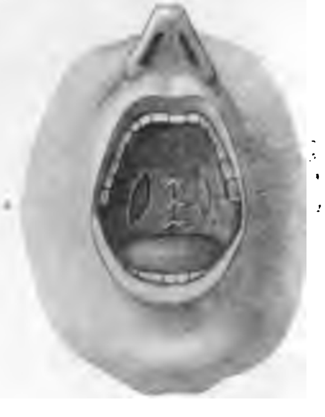


Fig 5



[illegible] & [illegible]

ple knot, confides it to an assistant, who holds it with a serre nœud (knot-tier) while he ties the second and then the first ligature, drawing them tighter than is necessary to approach the edges of the wound, in order to prevent any separation. This being completed, the ends of the ligatures should be cut close to the knots, and the patient kept from eating, drinking, or speaking during two or three days; the ligatures being removed on the third or fourth day, and the lowest ligature being left twenty-four hours longer than the others.

It is essential that the ligatures be placed at equal distances; that the points of each one be on the same level, and that they be at a proper and equal distance from the free edge of the fissure.* If, on knotting the ligatures, the strain upon the parts seemed to be too great, or such as might excite an apprehension of their tearing out, Roux made an incision in the sides of the soft palate, Plate XXVII. Fig. 5, and allowed these wounds to heal by granulations.

Operation of Jno. C. Warren.—In the case of a young girl, aged seventeen years, who from birth had suffered from a cleft on the left side of the uvula, extending as far as the ossa palati, where the fleshy membrane was so thin as to be transparent, the operation of staphyloraphy was performed by Jno. C. Warren, of Boston, as follows:—

"The patient being well supported and secured, a piece of wood an inch wide, a little curved at the end, and with a handle to be held by an assistant, was placed between the molar teeth on one side, to keep the mouth open. A sharp-pointed curved bistoury was then thrust through the top of the palate, above the angle of the fissure, and carried down on one edge of the cleft to its extremity, Plate XXVII. Fig. 3; and the same was done on the opposite side, so as to cut out a piece in the form of the letter V, including about a line from each edge. Next, a hook, or curved needle, fastened in a handle, with an eye on its extremity, and a movable point armed with a triple thread of strong silk, was passed double into the mouth through the fissure, and behind the palate, and the latter pierced by it at one-third the length of the fissure from the upper angle of the wound, so as to include about three lines of the edge of the soft palate. The eye with the ligature, being seen, was seized by a common hook and drawn out. The eyed hook was then drawn back, turned behind the palate, and the other edge transfixed in a similar manner. A second and a third stitch were now passed in the same way, the third being as near as possible to the lower end of the fissure. Then, seizing the upper ligature with the fingers, the knot was tied without using a serre nœud, and placed on one side of the wound in order to prevent its pressing on the fissure, the others being tied in a like manner, and the fissure closed. The patient was exhausted by the operation, but soon revived; remained twenty-four hours without speaking or taking a drop of liquid into her mouth, then used a little water. In seven days the stitches were removed, and she left the hospital a day or two after. Two years subsequently she swallowed perfectly and spoke well."†

In 1826 a similar operation was successfully performed on a boy, aged eleven. The cure was perfect.‡

Remarks on the American Operations.—The first of these operations is stated by Warren to have been original with himself, as he was not at that time acquainted with the operations performed in Europe. From the simplicity of the instruments employed, and the freshening of the edges from above downward, his method has advantages over that of Roux, from the fact that the incision of the soft tissues is facilitated by the traction, while the flap, being left adherent above until the completion of the opposite edge, is less likely to cause irritation about the fauces. That these two surgeons should devise similar expedients at the same time, and yet each be ignorant of the proceeding of the other, only shows the uniform tendency of different minds when devoted to the same object.

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* Bernard and Huette, p. 207. Paris, 1850.

† Amer. Journ. of Med. Sciences, vol. iii. p. 1, 1828; and MS. Records of Mass. Hospital.

‡ Ibid.

After the operation of Warren, A. H. Stevens, of New York, Sept. 1826, also operated successfully by first inserting the ligatures, and then paring the edges.*

Mettauer, of Virginia, in 1827, operated for staphyloraphy, and in 1837 published an excellent essay,† from which the reader may gain much that is of practical value. He employed the leaden ligatures recommended by Dieffenbach.

Wells, of Columbia, South Carolina, (1832,) in a case of recent wound, was enabled to apply the sutures by heating a surgeon's needle in a lamp, bending it to a proper curve, and passing it through the fissure by the aid of Physick's forceps.‡ This simple contrivance seems to have answered perfectly, and is certainly capable of supplanting all the more complicated instruments, and has been successfully used in staphyloraphy by various surgeons of Philadelphia.

Gibson,§ of Philadelphia, operated with instruments of a useful kind, some of which have been transferred to these pages.

Hosack, of New York, also published, in 1833, a memoir upon this subject, with illustrations of his own instruments; and Smith, of Baltimore, employs a peculiar hook or needle for the suture. L. A. Dugas‖ in 1860 cured a case of cleft palate, by employing the metallic suture, introducing five metallic threads and simply twisting them.

In fact, there are few operations in which surgeons seemed to have felt the necessity of more perfect instruments than in that of staphyloraphy. Each one has, therefore, endeavored to improve on those of his predecessor, and especially in reference to the introduction of the needles, thus showing that placing the ligatures is the most difficult step in the operation. The simplicity and efficiency of Physick's forceps removes, however, this great obstacle to the rapid performance of the operation.

The advantages resulting from the transverse incisions suggested by Roux, or the lateral sections practiced by Dieffenbach, have recently been more systematically presented and specially urged on account of their anatomical relations, by Ferguson, of London, in the *Transactions of the Royal Medical and Surgical Society* for 1845.¶ By many, the views of Ferguson are regarded as original; but the following facts show that he had been anticipated.

In connection with the history of an operation for fissure of the palate, J. Mason Warren published, in the *New England Quarterly Journal of Medicine and Surgery*, No. IV. p. 544, April, 1843, on account of the division of both pillars of the palate, and of its happy influence upon the union of the freshened edges of the fissure. Ferguson's paper did not appear until December 21, 1844, when, in the *Medical Times*, he published an account of the dissection, from which he was led to suggest the special division of the levator palati and palato-pharyngeus muscles. As he entered minutely into the anatomy of the structure concerned, and also demonstrated the importance of dividing these muscles, he has doubtless aided the progress of the operation; but it is apparent, from the references just made, that the idea was not a novel one, having been put in execution nearly two years previously by Warren. Froriep also appears to have been fully aware of the value of this muscular division, having described and figured the part in his *Notizen*, early in 1823.*

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* North American Medical and Surgical Journal, vol. iii. p. 233, 1827.

† Amer. Jour. of Med. Sciences, vol. xxi. p. 309, 1837.

‡ Ibid., vol. x. p. 32, 1832.

§ Instit and Pract. of Surg., vol. ii. p. 40.

‖ Dugas, in MS. April, 1860.

¶ Ferguson, Practical Surgery, p. 506. Philadelphia edition, 1848.

Mettauer, of Virginia, in 1837 also recommended the section of the muscles by repeated lateral incisions, as a preparatory step to the operation in cases of great loss of substance, allowing the parts to heal by granulations, as suggested by Velpeau in staphyloplasty.†

To Ferguson, however, is certainly due the credit of demonstrating, in a scientific manner, the special effects upon the fissure, of each of these muscles, though they had been previously divided without any reference to the anatomical details of the region.

SECTION II.

STAPHYLOPLASTY.

In the operation of staphyloraphy, as just detailed, the attempts of surgeons have generally been limited to cases in which the fissure was only in the soft palate, the opening in the bony structure being left untouched or covered up by a metallic plate. The following ingenious operation, by J. Mason Warren, of Boston, presents a plan of closing the opening in the bones, as well as that in the soft tissues, by means of a portion of the neighboring structure. As the opening is thus closed by a flap taken from the adjoining soft parts, and made to slide over the fissure, as in plastic operations elsewhere, the operation has been termed **Palatoplasty, Staphyloplasty,** or **Uranoplasty,** according to the position of the opening, either of which names is sufficiently applicable to the operations on any part of this structure.

Operation of J. Mason Warren, of Boston.—The patient being placed on a low seat, in a strong light, has his head firmly supported against the breast of an assistant, who raises or depresses it, as circumstances may require. The patient is then directed to keep the jaws widely separated, to retain any blood which may collect, as long as possible, so as not to embarrass the operator, and restrain all efforts at coughing, in all which he should be encouraged by the surgeon. The use of a speculum oris is deemed by Warren altogether inadmissible, as it obscures the light and prevents the proper manipulation of the instruments. The mucous membrane of the hard palate, being now carefully separated from the bones with a long double-edged bistoury, curved on the flat, should be rather peeled than dissected off, in consequence of the difficulty of making any sawing motion with the knife in this confined position, the obstacles being always greater in proportion to the obliquity of the palatine vault. As the dissection approaches the connection of the soft parts with the edges of the palate bones, where the muscles are attached and the union most intimate, great care must be taken lest the mucous membrane be perforated; and as soon as this dissection is terminated, it will generally be found that, by seizing the soft palate with the forceps, it can be brought into the median line. If the fissure is wide, and this cannot be effected, then the soft parts being forcibly stretched, a pair of long powerful French scissors, curved on the flat, should be carried behind the anterior pillars of the palate, and its attachments to the tonsil and to the posterior pillar carefully cut away, when the anterior soft parts will at once be found to expand and an ample flap be provided.

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* Chirurgische Kupfertafeln. Weimar, 1823.

† Am. Journ. Med. Sciences, vol. xxii. p. 309, 1838.

The edges of the palate may now be freshened by seizing them on either side with hooked forceps, and removing a slip with the scissors or sharp-pointed bistoury. A small curved needle, armed with a strong silk thread, confined in forceps with a movable slide, (Physick's,) should then be introduced at the upper edge of the fissure, and carried from before backward on the left side, and from behind forward on the right, or *vice versa*. Three or four ligatures being thus introduced, the patient should clear his throat of mucus and blood, the ligatures be wiped dry, and tied with deliberation, beginning at the upper and proceeding gradually downward, waiting a little between each ligature in order to allow the throat to accommodate itself to this sudden and almost imperceptible tension of the soft parts. No forceps are required for holding the first knot while the second is tied, the object being better effected by making two turns of the thread instead of one, and by enjoining perfect quiet on the patient until the second knot is tied.

Warren has always arrested the hemorrhage consequent on the incisions by iced water and the finger, and does not wait before introducing the ligatures. The ligatures also were generally removed in forty-eight hours, or on the third day; drinks were employed with caution from an early period, and the patient was nourished by oatmeal gruel in injections.*

Velpeau operated successfully, and closed an opening in the hard palate three-quarters of an inch long and half an inch broad, by the following means:—

Operation.—Having noticed that the fibro-mucous membrane of the palate, in consequence of its firmness and slight vascularity, was very apt to mortify and slough, either in whole or part, the operation was performed as follows: Two flaps, six to ten lines long, of a triangular shape, were cut, one from in front, the other from behind the opening, and dissected off, and brought down toward each other. These being united by means of a suture at their apices, a wound was left, which gradually closed up the fistula in every direction by the approximation and cicatrization of its borders, the cure being aided by a longitudinal incision, made from time to time upon the two sides of the opening, as well as by occasional transverse ones upon the root of each flap.

Statistics.—The results of this operation are shown by the following cases: Of twenty-four cases operated on by Warren, it appears that he has succeeded in twenty-three of them; and Roux, in 1842, obtained a success of two out of three in simple fissure, but of only one out of three when it was complicated with a fissure in the hard palate.

From a recent statement by Warren to the Boston Medical Society, it appears that this surgeon "has latterly performed five operations, in two of which the hard palate was badly fissured, and that all had proved successful. In one of these, where the fissure extended through the hard palate and alveolus, the soft palate and a portion of the mucous membrane, which was peeled off the palatine arch, united. In regard to the result of these operations, Warren also states that he has recently seen a young lady on whom he had operated some years since, and that the power of speech was quite restored, so that she enunciated with great distinctness. In almost every case the speech improved, the deglutition was easier, and the fauces were relieved from the dryness and inflammatory attacks to which they were formerly liable."

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* Operations for Fissures of the Soft and Hard Palate, (Palatoplasty,) by J. Mason Warren, M.D. New England Quarterly Journal of Medicine and Surgery, No. IV. p. 358. Boston, 1843.

CHAPTER X.

DISORDERS OF THE EAR.

THE importance of studying the derangement of an organ so essential to individual comfort and usefulness as the ear, is so evident that it might, at first, be thought that it would naturally attract the attention of every surgeon. Impressed with the idea that its structure is complicated, its disorders difficult to recognize, and the remedies advised often unavailing, there has long been, on the part of many, a disinclination to investigate these affections thoroughly, or a disposition to turn over patients thus afflicted to any one who would undertake their treatment. In consequence of this general professional neglect, the public have been gradually led to think that aurists belonged to a special class of practitioners, and quackery has readily taken advantage of the idea to advance its own selfish interests. That difficulties attend the attainment of a thorough knowledge of aural surgery must be admitted. Yet these difficulties are not greater than those met with in other affections, and can be readily mastered, while the result of a judicious treatment will frequently be entirely satisfactory, and occasionally so prompt, that both patient and surgeon will be gratified at the success.

After many years' experience, under favorable circumstances, I am fully convinced that aural diseases are not more difficult to diagnose or treat satisfactorily than are those of the eye or many other organs of the body; and though my present space must limit the consideration of the subject, it is thought that enough can be presented to serve the purposes of the general practitioner, and induce him to continue the investigation of these disorders, by consulting some of the excellent monographs written by the few whose attention has been specially devoted to them.*

SECTION I.

ANATOMY OF THE EAR.

Of the two portions of the ear, one is external, being the **Ear** of popular language, while the other, or the **Internal Ear**, embraces the structures mainly concerned in hearing. The external ear consists of a fibro-cartilaginous and fleshy substance, covered by the skin and attached to the side of the skull by ligaments and muscles, and of a cartilaginous tube which leads from the external to the commencement of the internal ear.

The lobus or soft and fleshy portion of the external ear is at the inferior extremity of the organ; when lost, it may be replaced by a plastic operation —**Otoplasty**—as hereafter described. The meatus auditorius externus, or the orifice of the cartilaginous tube, is at the bottom of a depression in the external ear known as the concha. Its orifice is about three lines in diameter. The canal itself is, in the adult, about one inch and a quarter long from the external meatus to the membrane of the tympanum, and is narrower in its middle than at either of its extremities. It is also more expanded downward than it is transversely, consequently foreign bodies may be most readily seized by forceps passed above and beneath the object, while the bivalve aural speculum should be opened in the vertical rather than in the transverse line.

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* Among these, I would name as especially useful and easily obtainable, Kramer on Diseases of the Ear, 1844; Wilde, Aural Surgery, 1853; Toynbee, Diseases of the Ear, 1860.

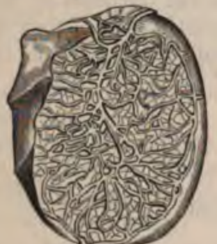
As the cartilaginous tube runs inward with a slight inclination forward, and a convexity upward in its curvature, it is requisite to pull the external ear *upward* and *backward* when it is wished to look to the bottom of the canal.

The diameter of the cartilaginous tube varies, sometimes readily admitting the end of the little finger, and at others being only of the size of a quill.

The cartilaginous tube is covered by the epidermis and dermis, these being continuous with the same tissues on the external ear. The osseous canal is part of the temporal bone. Between the osseous canal and the cartilaginous tube are found the periosteum of the bone, and an areolar tissue that is often the seat of abscess, as well as the ceruminous glands.

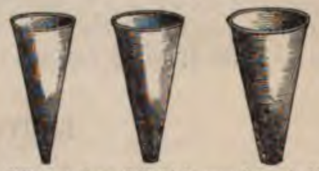
By straightening the cartilaginous tube by drawing the external ear upward and backward, dilating the external meatus, and so inclining the head that a strong ray of light can enter the canal, its condition throughout its entire length may be readily noted. The *membrana tympani* is a complete septum—Plate XXVIII. Fig. 1—which is found at the deepest extremity of the cartilaginous tube. It is placed very obliquely across the tube, so that its upper edge inclines outward, and its lower edge inward, the latter forming a very acute entering angle with the floor of the cartilaginous tube, and gives it an additional depth. With a good ray of light, a speculum like that of Wilde, Fig. 400, or some other, and the manipulation hereafter described, it is easy to recognize the condition of this membrane. The membrane of the tympanum or the **drum of the ear** is composed, according to the extended researches of Toynbee, of the following layers: 1, an epidermis, which is continuous with the epidermis of the external meatus and the cartilaginous tube; 2, of the derm, which is also continuous with that lining the tube; 3, of a fibrous layer composed of radiating and circular fibres, and continuous with the periosteum of the osseous canal; and, 4, of a mucous membrane, that is continuous with that lining the internal ear and throat.

Fig. 399.



A view of the vessels of the membrane of the tympanum.

Fig. 400.



Three different sizes of Wilde's speculum—half the size. (From the instrument.)

Though appearing as a bluish or gray semitransparent membrane, the membrana tympani contains a fine network of vessels, as shown by Arnold in his anatomical plates, as well as in Fig. 399, copied from Wilde. "The outer circle of the figure is the bony ring, and the central body is the cut-off extremity of the malleus." Inflammation will make the vascularity of this membrane quite apparent, and the pulsation of its vessels may be seen, as proved by Wilde.*

The function of the membrane thus constituted is to convey the sonorous undulations from the meatus to the ossicles, through which the impression of sound is made on the labyrinth. Any disorder of the drum becomes, therefore, a source of deafness, on the same principle that a change in the laminæ of the cornea impairing the transmission of the rays of light becomes a source of blindness. The healthy characteristics of the tympanic membrane should, consequently, be carefully studied before any attempt is made to treat its disorders, and, where its normal appearance is thoroughly impressed upon the observer, one great obstacle to a correct knowledge of a common cause of deafness will be removed.

Appearance of the Healthy Membrana Tympani.—When fully exposed to a ray of strong light, by some of the means hereafter mentioned in connection with the treatment of myringitis, the membrana tympani appears as a bluish or grayish semi-transparent membrane, stretched across the cartilaginous tube about *one inch and a quarter* from the external orifice of the ear. Its surface is slightly curved, and divided near its upper half by a white streak, which is caused by the attachment of the handle of the malleus, this streak corresponding with the insertion of the malleus into the fibrous layer of the membrane. The *anterior portion* of the membrane of the tympanum, when carefully exposed by straightening the auditory canal, looks like a thin tissue, of the appearance of fine gold-beaters' skin, reflecting a point of light from its most prominent portion. The posterior and inferior portion is also thin and glistening, but not so transparent as the anterior. The upper portion is thicker, whiter, and *concave* in a line with the superior wall of the cartilaginous tube, the epidermis and derm being reflected from this canal over the membrane of the tympanum.

If air is forced from the throat and cavity of the tympanum against the membrane, the anterior portion will become more convex and the upper portion pinkish from the congestion of the vessels in the line of the handle of the malleus. Congestion, which is one of the earliest pathological conditions of this membrane, may change the character of the epidermis covering the membrana tympani, and cause its scales to be thrown off, thus creating a white, parchment-like appearance, resembling the dura mater of the braïn, or rendering the membrane as pink as the fingers held before a candle in a dark room, while inflammation may render the anterior portion especially thick and opaque, like an inflamed arachnoid membrane, ulceration sometimes developing an opening with a corresponding change in the tension and concavity of the surface of the drum. A careful study of the appearances of this membrane is of great consequence; and if the student of aural surgery will only frequently examine the healthy ear of a friend, he will soon recognize, in disease, variations of color and translucency that language cannot well designate, and find the subject of aural disorders as readily recognizable as diseases of the thorax are by auscultation and percussion. Behind or within the membrane of the tympanum is the **Cavity of the Tympanum** or the internal ear, composed of various structures essential to hearing, as the labyrinth,

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* Op cit. p. 217. Phila. edition.

PLATE XXVIII.

OPERATIONS UPON THE EAR.

Fig. 1. A vertical Section of the Head, in order to show the angular course of the Eustachian Tube and of the External Auditory Canal. 1. The inferior turbinated bone. 2. The middle turbinated bone. 3. The pharyngeal orifice of the Eustachian tube, directly behind the posterior extremity of the inferior turbinated bone. 4. The angular direction of this tube. 5. The membrana tympani. 6. The external auditory canal; its direction completes the arch formed by the Eustachian tube. 7. The carotid artery.

After Bernard and Huette.

Fig. 2. A coil of silver wire forming a Spring for the retention of a Catheter in the Eustachian Tube, and attached to the nostril.

After Bourgery and Jacob.

Fig. 3. Itard's Frontlet for the same purpose. *After Itard.*

Fig. 4. A view of the Frontlet as applied. " "

Fig. 5. Perforation of the Tympanum by Deleau's Instrument. 1, 2. The instrument. 3. The membrana tympani at the point of perforation, so as to avoid the handle of the malleus. *After Bernard and Huette.*

Fig. 6. Removal of a Polypus, by the Forceps, from the External Auditory Canal. *After Bernard and Huette.*

Fig. 7. Fabriji's mode of strangulating Aural Polypi by the repeated application of the ligature with its canula. 1. The hand of an assistant holding the canula. 2. The second canula and ligature about to be applied below the first. 3. The fingers of the surgeon passing its loop over the first canula by means of a probe. *After Bourgery and Jacob.*

Fig. 8. A vertical Section of the Ear, showing the subsequent constriction of the base of the tumor. *After Bourgery and Jacob.*

Plate 28

Fig. 1

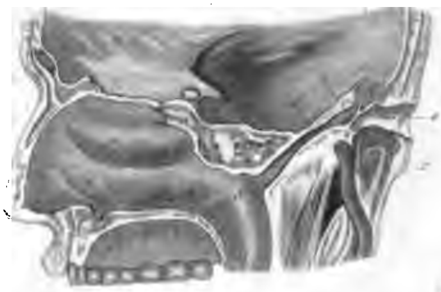


Fig. 4

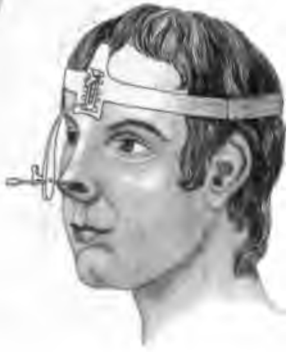


Fig.

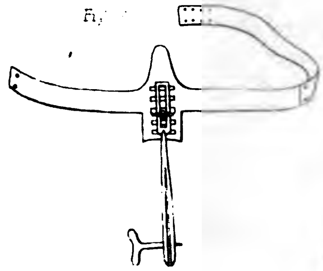


Fig. 3

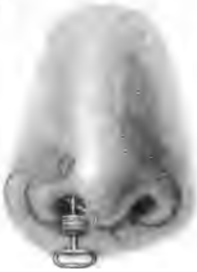
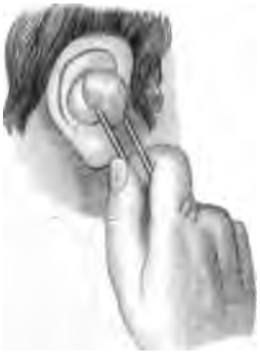
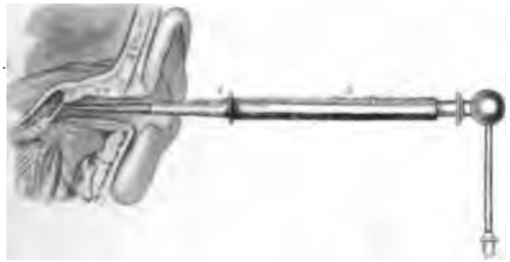
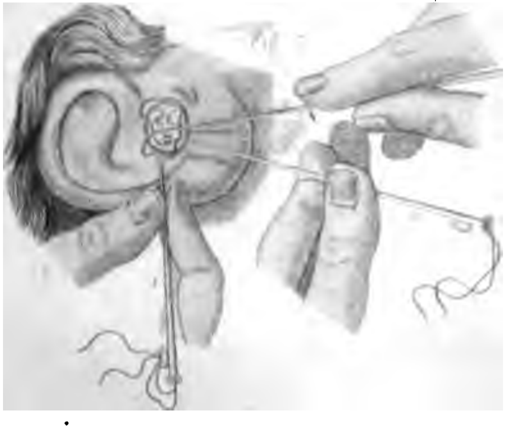
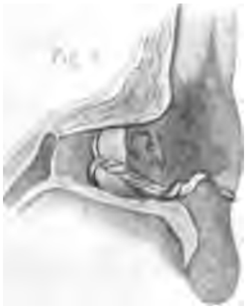


Fig.









cochlea, etc., all lined by a mucous membrane which is continuous with that seen in the pharynx. At the fore part of the cavity of the tympanum is the Eustachian tube, a cartilaginous canal that runs for six or eight lines in the petrous portion of the temporal bone, and terminates in a cartilaginous and membranous portion that opens into the pharynx at the posterior nares, Plate XXVIII. Fig. 1. The orifice of the Eustachian tube is found in the upper part of the throat, on a line with the posterior end of the inferior turbinated bone. It is rounded, oval, or trumpet-shaped, and large enough to admit the tip of the little finger, Plate XXVIII. Fig. 1. The canal in its whole length measures nearly two inches, and its course from the pharynx is nearly horizontal backward and outward toward the membrana tympani, diminishing as it goes backward, so as to receive with difficulty a small probe. It is lined in its whole extent by a fine and extremely delicate mucous membrane, which is continuous with that in the throat. In catarrhal affections, the mucous secretions of this membrane sometimes fill the whole cavity of the tympanum. The Eustachian tube is also liable to adhesions of its side, as well as to stricture, though both are rare.

SECTION II.

DISORDERS OF, AND OPERATIONS ON, THE EXTERNAL EAR.

Composed of the tissues already alluded to, it may be readily supposed that the **External Ear** would be liable to the diseases of the skin seen in this tissue elsewhere, and to the development of tumors, the production of wounds, etc. It is therefore unnecessary here to do more than mention that Eczema, Erysipelas, and Burns, of the external ear, are to be treated on general principles, care being taken that no permanent obstruction of the external meatus results therefrom. When the external ear is wounded so as to risk its attachment to the side of the head, the skin should be neatly fastened by a stitch or two of the lead suture, or, if possible, retained in its position by collodion, isinglass plaster, adhesive strips, a bandage, or some similar means. When the lobus has been removed, it may be replaced by otoplasty.

§ 1.—Otoplasty.

The formation of a new lobe for the ear is a plastic operation, invented by Dieffenbach, in which a proper-shaped flap is taken from the side of the head, or rather from the lateral portion of the neck, and, being slid from its original position, is fastened by sutures upon the deficient part. After union has taken place, the flap is cut free at its base, as in the operations of Rhinoplasty.

Another mode of operating will be found in the following method :—

Operation of Pancoast.—A piece of integument, rather larger than the natural size of the lobe, being marked out by an incision in front of the ear, a semicircular portion of larger size, but narrowed where it touched the cicatrix, was dissected up from behind the ear or over the insertion of the sterno-cleido-mastoid muscle. A sharp-pointed bistoury being then passed under the front portion of the ear, it was freed from its attachments by a single sweep of the instrument, and the everted edge of the tragus loosened with the knife, leaving a raw surface, which was of considerable size, and bled freely, but without requiring ligatures. The margins of the wound in front being closed with the hare-lip suture and adhesive plaster, the posterior flap was brought round over the lobe to the anterior portion of the ear, where it was fastened with two stitches of the interrupted suture; the parts presenting a good appearance, though the lobe was purposely made larger than natural, in order to admit of the shrinking which always ensues upon operations of the plastic class. The lower point of the ear, which had been strained downward by the cicatrix, retracted, when loosened during the operation, to nearly the natural length, and the success was perfect.

Remarks.—This operation, which is only a slight modification of that of Dieffenbach, was performed to relieve the cicatrix from a burn, the pinna being drawn close to the head, and the lobe lost in the common covering of the face and neck.

Any operation for the restoration of the lobe is, however, one of doubtful utility. At best, the restored portion cannot aid or affect the hearing, and will not much resemble the lobe, after a few months, while the removal of the flap produces cicatrices upon the neck, which are apt to cause a greater deformity than that arising from the original defect.

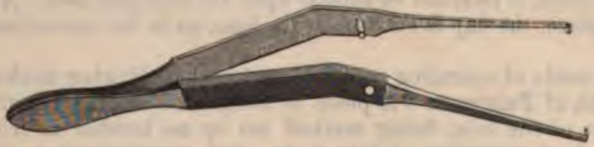
The removal of tumors from the lobe requires the same steps as those demanded by tumors elsewhere. In several cases reported by Norris, of Philadelphia, they resembled Keloides, and, as appears from his statement, are most common in the negro race, being the result of perforation of the lobe for the use of ear-rings.

§ 2.—Foreign Bodies in the Meatus Auditorius Externus.

Foreign Bodies, as found in the external meatus of the ear, are very varied, and may consist of insects, beads, coffee-grains, or similar articles, accidentally introduced into the meatus, or of collections of hardened wax, combined with epithelial scales, wool, hair, or other substances, either naturally or accidentally collected in the tube itself.

Extraction of Foreign Bodies.—Operation.—Whenever it is desired to remove an insect from the ear, the head of the patient should be inclined to one side, and the meatus filled with any mild oil or tepid mucilage, which is to be retained in the ear a few minutes, by keeping the patient's head in an inclined position. The oil or liquid thus occupying the tube closes the respiratory pores of the creature, and soon either kills it or causes it to seek the orifice, to obtain air or to escape, when it may be seized, or subsequently washed out with a syringe and tepid water, especially if inflammation exists, as this increases the sensibility of the part.

Fig. 401.

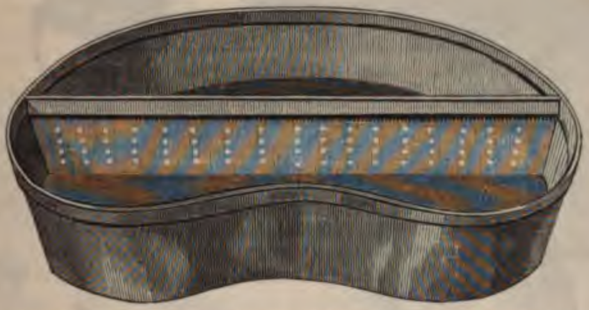


Ear forceps.

If the foreign body should be a hard substance, and one not capable of absorbing water, the removal may be attempted by the use of forceps like those shown in Fig. 401; but if the foreign substance cannot be removed without violence by this means, then the best plan will be to wash it out by the force of a stream of water gently thrown in on one side of it, and made to fly outward through the resistance created to its entrance by the surface of the membrane of the tympanum, as in the following plan :—

To Wash out Foreign Bodies.—Introduce the point of a large-nozzled syringe as near as possible to one side of the foreign body, there being very few that will distend the meatus so completely as to prevent the passage of a stream of water on one side. Then inject gently a full stream from the syringe, and the recurrent stream will generally bring the foreign substance to a point where it may be seized with the forceps or curette.

Fig. 402.

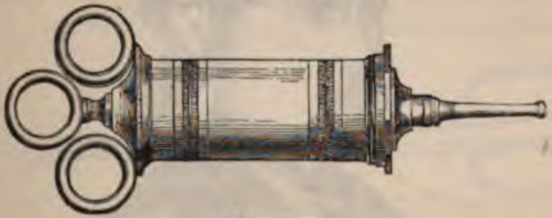


Wilde's ear basin—the perforations are intended to act as a sieve. (From the instrument.)

As the necessity of washing out the ear is often noticed in the treatment of deafness, the removal of hardened wax, or for the examination of the membrana tympani, the following method is given, as, though a simple operation, I have often seen patients soiled and annoyed by its imperfect performance :—

To Wash out the Auditory Canal.—Direct the patient to hold a large teacup, or basin, shaped as proposed by Wilde, Fig. 402, close under the lobe of the ear, and press it firmly against the mastoid cells. Then, while the ear is drawn upward and backward by the left hand, hold the body of a good two or four ounce ear syringe, Fig. 403, between the thumb and second finger, while the forefinger forces in the stream from the syringe by pressing on the piston. If the force of the stream is not too great, the water will all pass into, and not over the cup, and the patient's neck and clothing will not be in the least soiled, or even dampened, Fig. 404. Another method of protecting the patient in washing out the ear is shown in Fig. 405, where a tin or gutta-percha spout is attached to the head by a spring, and carries the water off into a cup held underneath it.

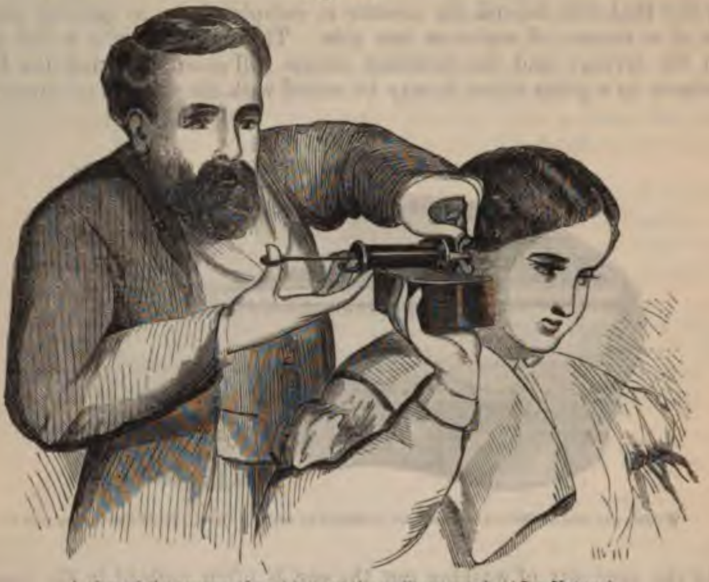
Fig. 403.



Ear syringe.

The syringe of Hullihen, of Wheeling, I have found to be objectionable, because it is apt to bruise the meatus.

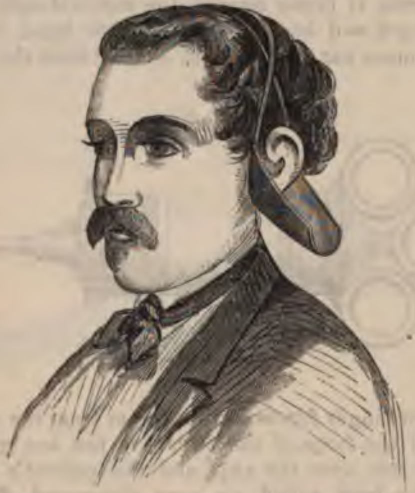
Fig. 404.



A view of the process of washing out the auditory canal. (After Nature.)

Remarks.—In introducing any instrument into the ear of an adult, the peculiarity of the shape of the external canal should be recollected. The operator should, therefore, pass it either from the top or bottom of the meatus, so that it may correspond with the largest dimensions of the canal, its

Fig. 405.



A view of Toynbee's ear spout for washing out the meatus. (After Nature.)

vertical diameter being greatest in this direction; but in a child it should be directed either toward the front or back of the meatus, as the transverse measurement is here the greatest. Hardened wax may be softened by warm oil or water applied twenty-four hours previously, and then washed out with the syringe, the ear being drawn upward, outward, and backward, in order to facilitate its escape, by straightening the cartilaginous tube.

Should every other means fail, the surgeon may resort to the plan of Paulus Ægineta, and, perforating the cartilaginous tube from below, introduce a probe behind the foreign body, and thus push it outward; but most frequently perseverance with the use of the syringe will suffice.

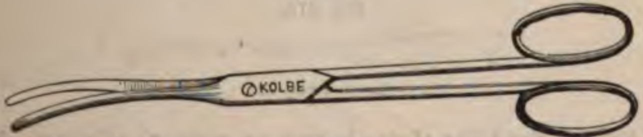
§ 3.—Polypi in the Meatus Externus.

Like other mucous membranes, that lining the external meatus and covering the membrana tympani may be the seat of those various morbid growths which pass under the common name of polypi, and which may here be produced under the same conditions and in the same manner as polypus elsewhere, whether in the nostril, uterus, rectum, or urethra. **Polypus of the Ear** generally arises from the walls of the meatus, near the orifice of the ceruminous gland, or from the surface of the tympanum, where, by filling the tympanic cavity, it causes the membrana tympani to ulcerate, when the polypus forces its way through, and shows itself at the external meatus.

Symptoms.—When a polypus forms in the ear, the patient begins to complain of frequent earache, for which he is unable to assign any cause, not being subject to neuralgia, and not having been exposed to cold, etc. Soon after this, a running from the ear, of a sero-purulent character, will be noticed, this discharge being the same as that which accompanies polypi, wherever situated. Next, he may suffer more or less from deafness, because the growth from the polypus obstructs the passage, and the altered character of the membrane itself, interferes with the transmission of the sonorous undulations; or, if the polypus has arisen from the side of the meatus, it may act as a foreign body, and plug up the canal.

The slightest ocular examination of the meatus will now at once reveal the true character of the disease, as in looking into it a fleshy-looking, smooth tumor can be seen, varying from the size of a pea to that of a tumor that fills the meatus.

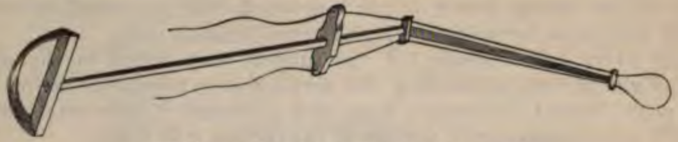
Fig. 406.



Ear polypus forceps. (From the instrument.)

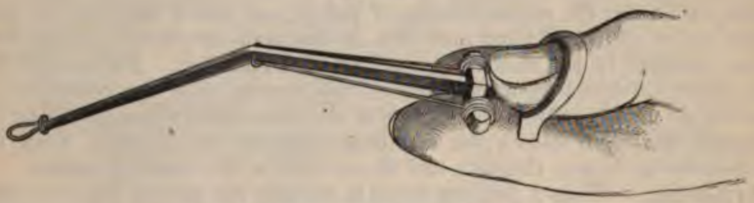
Polypi in the ear, like polypi elsewhere, may be of different kinds, that is, either soft, mucous, fleshy, or carcinomatous. Generally, these tumors arise from the cartilaginous tube near the seat of the orifices of the ceruminous glands, though they also spring from the tympanum, and project externally, Plate XXVIII. Fig. 6. If of the soft kind, they may be removed by seizing them with forceps, Fig. 406, and rotating the latter until the polypus is twisted, when simple traction will suffice to remove it; or, if it is possible to pass a loop around the growth, its strangulation may be effected by a fine wire ligature in a small double canula like that of Levret, or by the "snare" of Wilde, of Dublin, Fig. 407, which is a neat and useful instrument, and employed by holding the instrument on the thumb and drawing the wire noose with the fore and second fingers, as in Fig. 408. If more firm, the polypus may require excision in pieces, the hemorrhage being readily arrested by compression in the meatus, or by the application, with a camel's-hair pencil, of the liquor ferri persulphas. In all cases, however, it is usually desirable to apply the nitrate of silver to the seat of the tumor after its removal; to keep the meatus clean, by repeated syringing, and to employ astringent washes occasionally. The best mode of cauterizing the external auditory canal in cases of polypi is by means of the porte-caustic of Wilde, as shown in Fig. 409, the flexibility of the instrument preventing injury. Fig. 411 represents a cup for fusing the crystals of the nitrate of silver, in order to coat the flexible porte-caustic.

Fig. 407.



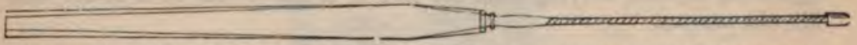
Wilde's snare for polypus. (From the instrument.)

Fig. 408.



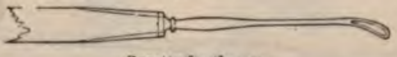
Mode of employing Wilde's snare. (After Nature.)

Fig. 409.



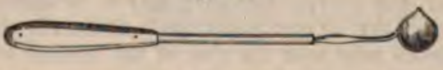
Porte-caustic of Wilde, for cauterizing the auditory canal or membrana tympani. (From the instrument.)

Fig. 410.



Curette for the ear.

Fig. 411.



Where the polypus is very large, and entirely fills up the meatus externus, the repeated applications of the wire ligature will often enable the surgeon to remove it entirely, but if not, it may be pared off from the tube by means of a narrow knife, Fig. 413.

Fig. 412.

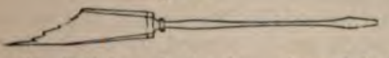


Fig. 413.

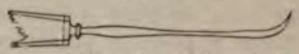


Fig. 412.—Knife for perforating the membrane of the tympanum, or excising a polypus. (From the instrument.)

Fig. 413.—Knife for excision of aural polypi from the external auditory canal. (From the instrument.)

Operation of Fabrizji, of Modena.*—The patient being so seated as to throw the light into the meatus, the surgeon should pass the loop of a wire ligature, contained in a double canula, around the polypus, passing it by means of a probe as far as possible into the auditory canal and toward the base of the tumor. Then, after firmly constricting it with this loop, let him next pass the loop of a second ligature in its canula, over the first, drawing upon the latter so as to carry the second ligature as deeply as possible, and, constricting the tumor by this, remove the first ligature and canula. If the second thread does not cause the tumor to come away, carry a silk or buckskin ligature in a flexible canula below it, and twist it until the tumor is cut off, Plate XXVIII. Figs. 7, 8.

Astringent washes are of but little value in checking the development of aural polypi, but I have derived benefit from applying, by means of a camel's-hair pencil, the finely-powdered sulphate of zinc, and allowing it to remain on the polypus, while the patient's head is inclined so as to favor the escape of that which is dissolved, repeating the application as required.

§ 4.—External Otitis.

By the general term **External Otitis** is designated an inflammation of the skin and areolar tissue connected with the external meatus and cartilaginous tube that is liable to result in thickening and a diminution of the calibre of the tube or in the formation of an abscess exterior to it.

Etiology.—The causes of otitis are blows upon the ear, pulling of the external ear so as rudely to stretch the auditory tube, foreign bodies left in the meatus or roughly extracted, exposure to cold draughts of air, bathing in cold water or exposure to a current of cold air while the body is warm, scrofula, and extension of inflammation from adjacent parts.

Symptoms.—The symptoms of external otitis are those of inflammation in similar tissues elsewhere—as violent pain, (described as earache,) with redness, swelling, and ultimately free suppuration.

Diagnosis.—When the inflammation is superficial, the heat and redness of the part render the diagnosis easy, but when the disorder is seated in the areolar tissue between the cartilaginous tube and the osseous canal, the distention of the tissue will be difficult, while the pus can only escape through the normal fissures of the cartilaginous tube, or find its exit through the meatus. In these cases an examination of the external canal may show redness and tumefaction about a half inch within the meatus, from which inflammation may be suspected. But if it does not, the chief diagnostic sign between otitis and otalgia is to be found in the fact that in otitis motion of the external ear upward and backward by straightening the canal will greatly augment the suffering, while it will not do so in simple otalgia.

Prognosis.—Acute external otitis requires usually three to five days before suppuration gives relief. If seen early, its progress may be more promptly checked.

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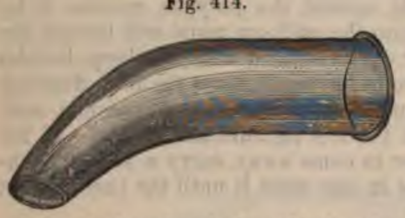
* Bourgery, Méd. Opérat., tome vii. 7me, p. 33.

Treatment.—The treatment of otitis should be based on the general principles of inflammation elsewhere—the redness and congestion of the early stage being arrested by leeches applied just within the meatus, and the suppuration, if possible, prevented; or when pus is formed, by evacuating it promptly.

The best means of accomplishing the first is by a prompt and thorough leeching, four to six European leeches being applied in front, below, and around the meatus, by means of a curved glass tube, Fig. 414, so as to draw two or three ounces of blood from the adult—the mouth of the patient being kept open so as to relax the tissues around the meatus, and the latter filled with cotton to prevent the entrance of a leech, after which cloths wrung out of warm water and covered by oiled silk should be kept constantly applied, or a wet cloth may be wrapped around a hot stone or flat iron, and the head placed on it, so that the moist, warm vapor may enter the meatus. Of course, proper precautions must be taken to have sufficient cloths, to prevent burning. When blood accumulates in the meatus after leeching, it should be gently washed out by syringing. When the throbbing and buzzing is marked, and the slightest motion of the ear is painful, the gentle injection of warm mucilage—as warm as can be borne—is very soothing. Laudanum and warm oil, so often employed in domestic practice, should be especially forbidden, the alcohol of the laudanum being an increased source of irritation, and tending to inflame the membrane of the tympanum. While no one would think of pouring warm oil and laudanum into an eye, every by-stander is ready to recommend it for the ear. Trousseau, of Paris, speaks well of the extract of belladonna, rubbed up with a little water and glycerin, and then applied within and around the external meatus by means of a pellet of charpie or lint saturated with it. A morsel of lint moistened with chloroform and placed within the bowl of a tube or pipe, the stem of which may be introduced into the meatus, will afford a simple mode of applying anæsthetic vapor. Blowing into the bowl of the pipe will cause the vapor to enter the ear. As thus applied, the anodyne effect is obtained without there being such increased vascular action as follows the use of laudanum when poured into the ear. Gentle friction within, around, and below the meatus with an ointment containing one grain of aconitia to the drachm of cold cream, will also allay the pain. The popular remedies of the core of a roasted onion, or a hot fig, should be avoided, heat and moisture being better applied by the warm water-dressing. When pus has evidently formed beneath the cartilaginous tube, it should be evacuated, if possible, near the meatus; if not, it had better be left to nature. When the abscess breaks, frequent and gentle washing of the canal with warm water will be very useful.

Fig. 414.



A glass tube for applying leeches within the orifice of the meatus. (From the instrument.)

But while attention is thus given to the local remedies, the general treatment must not be overlooked, smart purging with mercurials, or the administration of a few grains of the blue mass, followed by a saline cathartic, proving highly advantageous. In some instances, after the evacuation of an abscess, or after the acute stage of otitis has passed, an eczematous eruption will be noted extending within the meatus. At other times desquamation of the epidermis lining the tube follows, both being liable to impair the hearing, as will be again alluded to under the head of deafness. In chronic external otitis, as in many other forms of aural inflammation, counter-irritation close beneath, in front, and behind the external meatus will be found highly serviceable. This may be best accomplished by painting the part with pure creosote, or with cantharidal collodion.

§ 5.—Myringitis and Injuries of the Membrana Tympani.

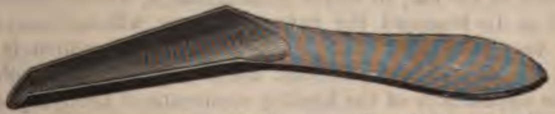
In the account of the structure of the ear, the composition and position of the membrane of the tympanum were alluded to. As the epidermis as well as the derm of the external cartilaginous tube are continued upon the drum, inflammation of the former is very apt to be followed by that of the latter, and the consideration of the disorders of this membrane thus follow naturally those of the external meatus, and **Myringitis**—*myringa*, the membrane of the drum—is the name well applied by Wilde, of Dublin, to indicate inflammation of this structure.

Causes.—Though frequently consequent on external otitis, myringitis often exists independently of it, and may be due to the accumulation of hardened wax in the external tube, to the extension of an eczematous irritation, to sudden concussion by blows on the ear, by the firing of cannon, etc., or to the extension of inflammation from the cavity of the tympanum, to rheumatism, catarrh. Myringitis may exist either in the acute or chronic form, corresponding, in many points, with corneitis or inflammation of the cornea, in diseases of the eye, the chronic variety being the most common.

Symptoms.—Severe, often intense pain within the head, which is increased by coughing, sneezing, or any act that will cause the air to distend the membrane of the tympanum is usually noted, the pain, if due to a rheumatic attack, being also complained of in the temples, eyes, and brain. As the acuteness of the pain diminishes, the patient also complains of dizziness, buzzing in the head and ear, while the temper is irritable in the extreme, the slightest noise or attempt to speak, or an effort to swallow, causing loud complaint. When consequent on a catarrhal affection, there is also usually present the ordinary symptoms of a catarrh, while fever, a disordered digestion, with irregular chills, and not unfrequently slight delirium, are often seen in marked cases.

Diagnosis.—As the condition of the membrana tympani can only be recognized by examination, the proper mode of proceeding will be that now given.

Fig. 415.

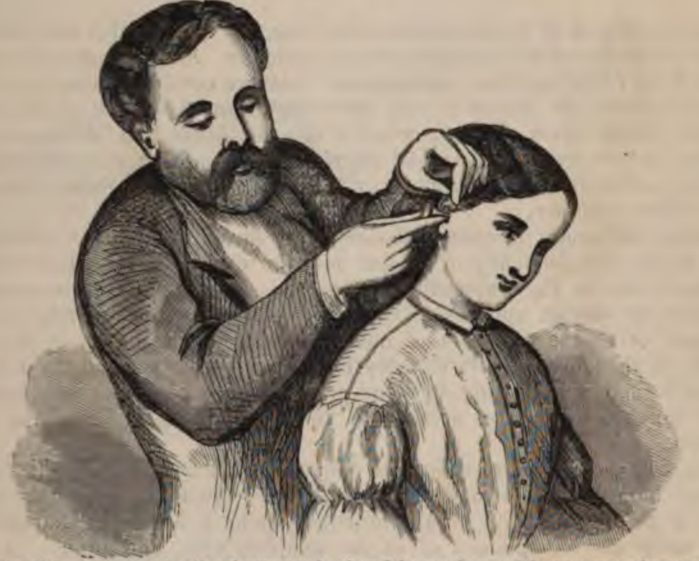


Wilde's instrument for depressing the tragus. (From the instrument.)

Examination of the Membrana Tympani.—In a large open meatus with a strong ray of light, draw the external ear upward and backward, and with the little instrument of Wilde, Fig. 415, or a pencil, or the finger, push the tragus forward; then, keeping the observer's head out of the way, incline the patient's head to a proper angle to throw the light into it, and the membrane may be readily seen. But as the meatus is often small, it is better that a speculum should be used, and the examination made as shown in Fig. 416.

Light.—The sunlight is the best in all cases, but as this cannot always be obtained in a room, in consequence of its position, the following plan, as proposed* by A. Young, Jr., of Maine, will be highly useful:—

Fig. 416.



Position of the surgeon and patient in an examination of the membrane of the tympanum by sunlight with Toynbee's speculum, the surgeon carefully keeping his head so as not to obstruct the rays of light as he looks through the speculum into the ear. (After Nature.)

Young's Mirror, or "**Solarscope.**"—"To a foot, or base-board, about eight inches square, attach a rod two feet in length, bearing a sliding ring with thumb-screw, and an armature twelve inches long, having at the end a ball-and-socket joint with a thumb-screw, and another short armature to hold a mirror six inches square.

"To use the instrument, raise the lower sash of the window and place it upon the sill, resting the beam of the sash upon the top of the rod. Swing the armature out of the window, and by means of the thumb-screw adjust the mirror so as to direct the rays of the sun to any part of the room you please."

Various other plans have also been suggested to throw the rays of light upon the drum of the ear, of which **Hutchinson's,** which consists of a mirror so arranged as to transmit the rays of a lamp, will be found to be a good one; while that of **Grant,** of Newark, New Jersey, which is adapted for the rays of the sun, though artificial light may also be employed, will be useful. The appearance of the healthy membrane of the tympanum has been already described, p. 196.

When the room has a south exposure, the rays of the sun will often so fall as to render a mirror unnecessary, yet even then it will sometimes be useful to employ one. A strong light being essential, when circumstances prevent the use of the sunlight, that of a wax or spermaceti candle may be substituted, a little mirror being attached by a wire to the candlestick; or Miller's lamp, Fig. 417, may be resorted to, as advised by Toynbee. The bivalve, or Itard's speculum, Plate XXIII. Fig. 10, though useful, sometimes causes pain if incautiously expanded, and requires more attention in manipulating than that of Toynbee, Fig. 418, or that of Wilde before shown, either of which I regard as the best of those at present made by the cutlers.

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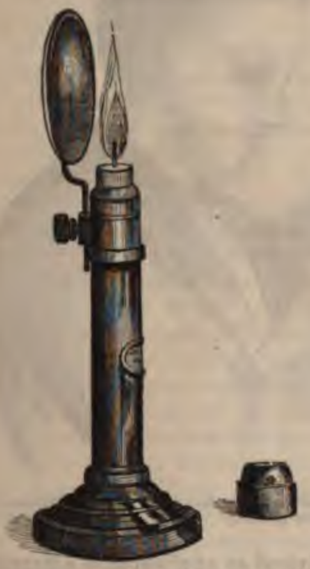
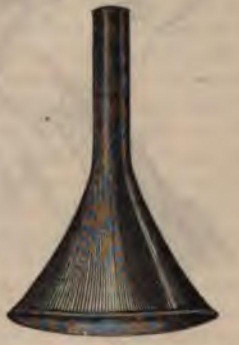
* New Orleans Med. News, Feb. 1860, from Bost. Med. and Surg. Journ.

Fig. 417.



Miller's lamp. The cover of the candle when not in use is seen on the right side of the cut. (From the instrument.)

Fig. 418.

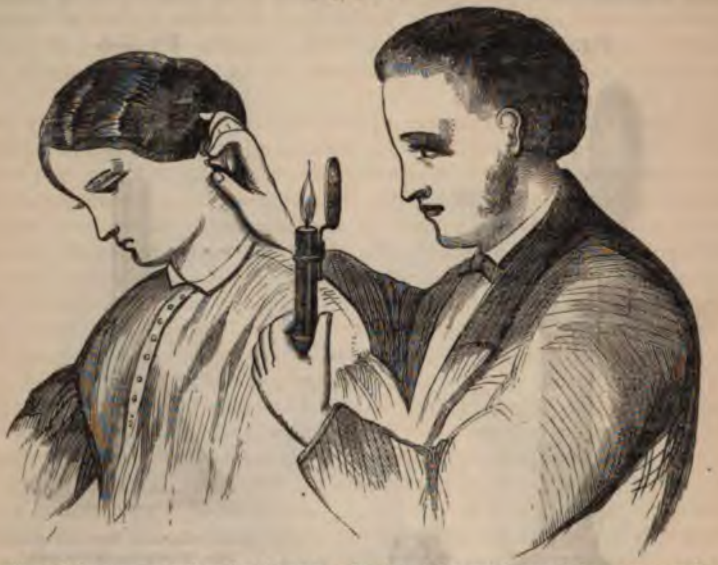


A medium size Toynbee speculum. (From the instrument.)

The mode of examination is graphically shown in Fig. 419. When, by these means, the membrana tympani is fully exposed in a case of acute myringitis, we may note a tumefaction of the external auditory canal, with more or less edema and redness, a bright pink or damask hue of the membrane of the tympanum, especially on its circumference, like the vascular circle around the cornea in a case of iritis; or the color may be of a dull orange-yellow, according to the acuteness of the attack and the character of the congestion, the vessels sometimes inosculating all over the surface of the membrane in a manner analogous to that seen in ulceration or chronic inflammation of the cornea. Indeed, acute myringitis, in its appearance, course, and changes, closely resembles corneitis; when ulceration results, the ulcer will usually be found in the portion anterior and inferior to the handle of the malleus.

Prognosis.—The prognosis of acute myringitis should be guarded, as the result in reference to the hearing of the patient is very uncertain. Sometimes myringitis, especially if slight, is followed simply by desquamation of the epidermis covering the membrane; at other times fibrin is effused between the two laminæ of the fibrous coat, which will leave an opacity and thickening that will greatly impede hearing, and be almost as difficult to remove as similar opacities in the cornea; or ulceration may leave a permanent loss of tissue and consequent destruction of the function (vibration) of the membrane; or the myringitis may be complicated with **tympanitis,** (inflammation of the cavity of the tympanum,) and this be followed by polypus, otorrhœa, necrosis of the ossicles, and entire destruction of the ear as an acoustic instrument. The termination of the acute stage of the disorder varies from a week to ten days; the deafness, etc. may last indefinitely.

Fig. 419.



Position of the surgeon and patient in an examination of the membrane of the tympanum by artificial light. (After Nature.)

Treatment.—The treatment before advised as applicable to external otitis is equally useful in acute myringitis—purgatives, diaphoretics, and anodynes being actively employed. The general principles applicable to corneitis are also applicable to acute myringitis, except that mercurialization, which is liable to prove injurious in corneitis, and to induce sloughing of the cornea, is advisable in the treatment of myringitis. A mercurial purge, followed by small doses of Dover's powder, will often prove an important part of the treatment of acute myringitis; counter-irritation near the meatus, by the application of creosote, as advised in the treatment of otitis, being also very serviceable.

Subacute and chronic myringitis will be referred to under the section on Deafness.

SECTION III.

DISORDERS OF THE INTERNAL EAR.

§ 1.—Internal Otitis.

The cavity of the tympanum, being formed in the petrous portion of the temporal bone, is lined by periosteum, and this again is covered by a mucous membrane which is continuous through the Eustachian tube with the mucous lining of the throat, and is reflected over the posterior or inner face of the membrana tympani. The inflammation of either or both of these tissues is designated as **Internal Otitis,** or, more correctly, *Tympanitis*—

though, as usage has assigned the latter term to flatulent distention of the belly, Internal Otitis is the best term.

Causes of Internal Otitis.—Exposure to cold and dampness, so as to check perspiration, wet feet, and all such causes as develop a catarrh, are liable to create congestion of the mucous membrane lining the cavity of the tympanum, and at a later period periostitis in this cavity. In children a slight congestion caused by cold is the usual condition known as "earache." Scarlet fever, rheumatism, gout, scrofula, syphilis, or small-pox may also create such inflammation of the mucous lining of the tympanum as will develop internal otitis.

Symptoms.—The symptoms of internal otitis depend greatly on the extent, degree, and duration of the inflammation. In catarrhal otitis, and in the milder form seen in children, there is usually more or less sense of obstruction or stuffing, with buzzing and now and then a bursting or crackling sound in the ear, with more or less pain, often of a severe character, and especially violent at night. In this form we recognize the results of congestion, increased secretion of mucus, edematous thickening, and sometimes suppuration of the mucous lining of the cavity of the tympanum. When, as in scarlet fever, the irritation of the mucous membrane of the pharynx extends to that lining the cavity of the tympanum, suppuration is quite common. Examination of the membrana tympani at this period will show a color like that of chronic inflammation of the skin, a peeling or desquamation of the exterior layer of the membrane, and sometimes a distention of the membrana tympani outward, in consequence of the accumulation of matter within the cavity of the tympanum, while the Eustachian tube is obstructed by edematous inflammation. Ulceration of the membrana tympani giving exit to the pus, the symptoms of otorrhœa, as hereafter described, will become apparent. When internal otitis is well developed, more or less constitutional disturbance, as fever, partial delirium, slight coma, moaning, tossing of the head and general restlessness, may be noticed.

Diagnosis.—Internal otitis, if present for a few hours, generally develops more or less myringitis; but the latter may be told from the former, if existing separately, by the greater acuteness of the pain, by its increase on straightening the cartilaginous tube, by the permeability of the Eustachian tube to inflation by the patient, and by the marked bright congestion of the membrane of the tympanum, as compared with the browner hue of internal otitis.

Prognosis.—The prognosis of internal otitis depends greatly on the violence and duration of the inflammation. In the simpler form a discharge of serum or mucus into the throat, with relief of pain and the catarrhal symptoms, is the usual result; while in the form consequent on scarlet fever and scrofula, the destruction of the membrana tympani, necrosis and discharge of the ossicles, permanent thickening and obstruction of the Eustachian tube, thickening of the lining membrane of the labyrinth, are very apt to supervene, and thus induce permanent deafness.

Treatment.—In the treatment of acute internal otitis prompt measures are necessary to arrest the progress of the disorder, such as free leeching around and within the external meatus, warm and moist cloths to the side of the head, mild gargles, painting the pharynx with a moderately strong solution of nitrate of silver, a brisk purge, and the measures before alluded to in the treatment of myringitis.

When an examination of the membrana tympani shows its distention, its early puncture and the evacuation of the contained liquid will greatly expedite the cure, an incision of this membrane healing more readily than an ulcer. The treatment of the disorder, when otorrhœa is developed, will be given hereafter. As suppuration in internal otitis, with closure of the orifice of the Eustachian tube by pharyngitis, converts the cavity of the tympanum into a circumscribed chamber, no hesitation should be felt in puncturing the membrana tympani, giving exit to the pus, and preventing the development of caries or necrosis of the ossicles, or the extension of the suppuration to the mastoid cells.

The puncture may be made by a needle, Fig. 412, a short, straight-pointed bistoury, or, still better, by means of Deleau's instrument, prepared especially for the purpose, Plate XXIII. Figs. 18, 19; taking good care, however, whatever be the instrument employed, to avoid striking the handle of the malleus, as hereafter shown. Having thus got rid of the pus, tepid water may be carefully injected into the meatus, with the view of thoroughly washing it out, when the symptoms will generally be much alleviated. The after-treatment is the same as that of any other abscess, the little wound in the tympanum healing rapidly like any other incised wound, and with the greater rapidity because the previously distended membrane having now collapsed, the edges of the punctured wound are brought into accurate juxtaposition. Indeed, this is sometimes so readily effected after perforation of the membrane of the tympanum, that in those cases where it is desirable from any cause to keep the wound open, a free crucial incision or the use of caustic is necessary to obtain that result.

Should the timidity of the practitioner lead to a neglect of these measures and the pus be not evacuated, the membrane will not be saved, as its distention by the pus will terminate in ulceration, the ulcer that is left being difficult to heal and often destroying the whole membrane, while the luxuriant granulations from its edges may give rise to a fungus that will fill the meatus. Or if ulceration does not take place, or if the membrane of the tympanum does not rupture, still the irritation will impair its usefulness by leading to a deposit of lymph and the formation of adhesions that will limit the vibrations of the stapes; or the membrana tympani will become so thickened that it will cease to vibrate. If pus collects and the membrane is ruptured, the ossicles may also be loosened from their connections and be discharged with the pus that escapes, the patient being thus rendered permanently deaf, a condition not unfrequently seen in children as one of the sequelæ of scarlet fever. When the membrana tympani is ruptured, a patient can generally be made to show it by directing him to close his nose and mouth and expel the air from his lungs, when, if the Eustachian tube is still patulous and the membrane is ulcerated, the air will escape from the external ear. Ulceration or perforation of the membrane, from any cause, will also account for the power sometimes observed in certain individuals of expelling tobacco smoke from their ears; a most dangerous practice, as the irritation of the smoke is liable to lead to inflammation of the internal ear, and thus result in permanent disorganization of the organ.

The treatment of the internal otitis which arises during scarlatina, or as a sequel to it, is plain. As the irritation and inflammation started originally in the pharynx, the first remedies should be addressed to the throat, careful treatment of the pharyngitis during this fever often preventing the condition of the ear under consideration. But should internal otitis occur notwithstanding these precautions, it should be promptly treated by perforating the membrana tympani and evacuating the pus.

§ 2.—Chronic Otitis.

Chronic Otitis is, as its name imports, a variety of the affection just described. It is similar in its relative results to chronic inflammations in other mucous membranes, as chronic conjuctivitis, chronic gleet, etc., and is to be treated on the same principles, the greatest service being obtained from counter-irritants and slight mercurial alteratives, this treatment being steadily persevered in for months in order to obtain benefit.

Cases of chronic deafness, in which the patient hears imperfectly under ordinary circumstances, though he can hear distinctly the ticking of a watch when placed between his teeth or against his mastoid cells, so as to receive the reverberation of sound that passes through the bones of the cranium to the ear, are usually cases of chronic otitis. They are by far the most frequent forms of deafness, and are sometimes spoken of as cases of nervous deafness, and pronounced incurable, though really due to chronic inflammation and thickening of the mucous membrane of the internal ear. They will hereafter be alluded to under the section on Deafness.

§ 3.—Otorrhoea.

Otorrhœa is the name applied to any irritation which results in a puriform discharge from the external ear. It is often a sequel of external as well as of the internal otitis most frequently seen in children, and consists in the free discharge of pus, ichor, or sanies from the external meatus, accompanied by eczema of the meatus, and more or less deafness. If there is caries or necrosis of the small bones of the ear, or of the mastoid cells, the discharge will be exceedingly offensive, presenting the ordinary characteristics of discharges from dead or diseased bones, the sulphuretted hydrogen contained in the discharge under these circumstances not unfrequently blackening the parts around the ear, and producing appearances which are quite characteristic, especially when lead-water has been used as a wash. Otorrhœa supervenes on ulceration of the membrane of the tympanum, as a result of scarlet or other fevers. It may also be due to inflammation in the external laminæ of the membrane of the tympanum, or to that lining the external meatus and cartilaginous tube.

Diagnosis.—The escape of the matter renders the diagnosis easy, though, until the external ear is thoroughly cleansed, it is often impossible to tell the precise origin of the suppuration.

Prognosis.—The prognosis depends on the cause, otorrhœa being generally only a symptom of inflammation in some of the tissues lining the bony cavities of the ear.

Treatment.—In all cases of otorrhœa it is important to wash out the ear thoroughly, and examine the canal and membrana tympani by means of a speculum. Syringing the ear should be practiced, as previously directed, with tepid water, or tepid soap and water. After thoroughly washing out the meatus, the membrane of the tympanum should be examined by means of the speculum auris, described in myringitis. This examination will at once show whether the tympanic membrane is thickened or diseased, and whether it has been destroyed by ulceration, or is distended by pus.

The alterative local treatment of otorrhœa should be conducted upon general principles, whether the disease involves merely the external meatus or the whole internal structure of the ear. When otorrhœa has existed for a length of time, there is the same indication for the application of astringents that exists for their employment in chronic inflammations of mucous membranes elsewhere. Injections, therefore, may be thrown into the ear, consisting of solutions of sulphate of zinc or nitrate of silver, of the strength of one grain to the ounce of water, or the liq. plumb. subacetat. may be advantageously substituted in the proportion of gtt. vj to two or three ounces of water, the quantity being augmented in accordance with the chronic character of the discharge. When the membrane of the tympanum is not involved in the disorder, it will be better, however, to apply these washes by means of a pellet of charpie saturated with them, and to leave the pellet in the canal, loosening it by syringing before attempting its removal. In this way the wash will be prevented from irritating the membrane of the tympanum. The practice of pouring liquids into the ear, unless they are intended to come in contact with the drum of the ear, is highly improper, and may develop myringitis.

The constitutional treatment of otorrhœa is also important, as the disease is very common, perhaps most common among tuberculous children. Here, the general treatment of the tuberculous diathesis must be adopted, as the use of the iodide of potassium, cod-liver oil, tonics, etc.

The inflammation of the mucous membrane, which produces otorrhœa, sometimes also results in ulceration of the membrane of the tympanum, in consequence of which fungous granulations sprout from the ulcerated surface, so that upon looking into the ear these fungous granulations can be readily seen, their appearance being such that they may readily be mistaken for polypus of the ear. The former, however, possess a mulberry-like surface, which is quite characteristic, while polypus presents the appearance of a fleshy tumor, with a surface that is generally smooth and even.

In the adult, otorrhœa is sometimes caused by the presence of foreign bodies in the meatus, and not unfrequently from accumulations of the secretion of the ceruminous glands, mingled with dirt, dust, epithelial scales, and other matters. Many individuals, who are very cleanly in other respects, are not unfrequently careless in regard to the condition of the external ear, never washing it out, and merely removing the wax from time to time with an earpick. When a person of such habits goes on a journey, the dust and cinders of the road collect in the ears, and, becoming adherent to the wax, the patient soon finds himself quite deaf, a condition which he generally ascribes to the effect of the noise of the cars instead of its true cause. This accumulation of dirt and wax in the external ear, if allowed to remain, will soon act as an irritant, precisely as any other foreign body would, and many cases of otorrhœa in healthy adults who have not suffered previously from an attack of otitis, will be correctly attributable to this cause, and relieved by simply syringing the meatus, with the subsequent use of mild astringents.

Perhaps few disorders are more amenable to a judicious treatment, or likely to result in permanent injury, than that just alluded to under the general term otorrhœa; a term only expressive of a symptom, not of a pathological condition, and yet one that usage has rendered so popular that it cannot be advantageously discarded.

The following points connected with otorrhœa may be remembered in connection with its treatment:—

1st. All discharges from the ear, or "running from the head," should be regarded as evidence of the existence of acute or chronic inflammation of some of the tissues entering into the composition of the ear.

2d. All inflammations of the ear should be arrested as soon as possible, in order to prevent a change of structure.

3d. All discharges from the ear should be promptly arrested, *provided*, as in other discharges, they are not a natural effort to relieve congestion. When this is the case, the reduction of the inflammatory action will arrest the discharge.

In few points of aural surgery will there be more evidence of ignorance presented to the surgeon than in this of otorrhœa; many practitioners, and a yet greater number of patients, insisting that the arrest of a discharge from the head will expose the patient to an attack of congestion, or some other disease of the brain. Such an opinion is the result of ancient prejudices and of the influence of the humoral doctrine, though altogether inconsistent with our present anatomical and pathological knowledge of the ear. How judiciously arresting an external or internal otitis, and thus curing an otorrhœa, can act on the brain, is not apparent. When, then, otorrhœa is present, let the ear be carefully examined; let the inflammation of the dermis lining the cartilaginous tube, or that of the membrani tympanum, be checked; let polypi be removed, and inflammation of the mucous lining of the cavity of the tympanum be arrested, and the discharge will cease. Who ever hesitates at arresting, judiciously, a gonorrhœa or diarrhœa? Who now hesitates at curing a fistula in ano, or a herpes, or eczema, under any circumstances? Why, then, should prejudice be allowed to arrest the cure of a discharge whose existence is evidence of the presence of an inflammation that is a source of danger to the organ so long as it is permitted to continue? Let no surgeon, then, delay in removing, as soon as possible, an eczema or intertrigo behind the ear, or in checking otorrhœa when inflammatory action can be arrested at the same moment, as numerous little patients can be found in whom permanent deafness has resulted from the fears of friends and others being excited about "checking a running from the head."

SECTION IV.

DEAFNESS.

Deafness is the general term under which, in popular language, any impairment of the organ of hearing is described. In the varied structures of the ear, a variety of changes may be noted, all of which may be referred to the general head of Inflammation, the consequences of which impair the usefulness of the ear as an acoustic instrument. Now, although it would be a more scientific arrangement to allude to deafness only as a symptom of certain inflammatory changes in the tissues concerned, yet it will probably be more practically useful to call attention to the defect of hearing as the great point to be overcome, and then allude in a general way to such pathological conditions as have been already referred to, and which are especially important as causing deafness.

The natural perfection of the ear varies greatly; some persons having the sense of hearing very acute, others being more dull, and each having it greatly influenced by the mental process of attention, or listening. In order to establish some general standard, the departure from which shall indicate the degree of disease, it may be assumed that a healthy ear of an intelligent person will readily recognize the ticking of a lever watch at a distance of three feet from his head, or at his arms' length. Some can hear at a greater distance, but this is a good average. Any marked inability to hear at this distance may therefore be regarded as constituting *deafness*, or impaired hearing.

§ 1.—Deafness from Excess of Wax.

Deafness may be produced by any cause that will interrupt the vibration of the rays of sound upon the membrana tympani, and the several conditions of the ear before described are liable to create it; the most common, and the first to which attention should be given, being the accumulation of wax or of the secretion of the ceruminous glands, which, when allowed to collect within the meatus, becomes mingled with particles of dust and dirt and other foreign matter, so as to obstruct the canal, not only producing at times the otorrhœa already referred to, but also creating more or less dullness of hearing. There is also a true increase of activity in the ceruminous glands, leading to a considerable augmentation in the quantity of wax produced, which creates a similar condition. When from either of these causes wax accumulates in the meatus, and becomes hard and inspissated, it acts like a plug, and produces very marked symptoms, of which the imperfect hearing is usually that which most attracts the patient's attention.

Symptoms.—In the deafness from accumulated and inspissated wax the patient complains not only of loss of hearing, but of roaring and ringing in the ears. When the meatus is examined with a speculum under these circumstances, it will generally be found to be diminished in depth, and to have at its bottom, say within three or more lines of the external meatus, a dark-brown or blackish body which blocks up the passage completely. If this wax has become very dry from evaporation, or any other cause, it will be movable, and sometimes rattle in the ear; but if it is yet soft, and adheres to the sides of the meatus, it will often be found adhering firmly to the epithelial covering of the canal, and sometimes to the epidermis covering the membrane of the tympanum. As in the attempts of nature to get rid of this mass, inflammation is not unfrequently developed, pus is soon secreted, as already shown in connection with otorrhœa.

Diagnosis.—Inspection with a speculum, after washing out the canal, as far as is possible, renders the diagnosis easy.

Prognosis.—The prognosis, as regards the removal of the wax, is certain. As respects the cure of the deafness caused by it, this will depend mainly on the degree of inflammation that it has developed in the membrana tympani.

Treatment.—As this wax is a foreign body, and as such requires removal by such means as will at once free the passage and thus enable sound to reach the membrane of the tympanum, the plan of treatment should be conducted as follows: Drop into the ear, at bedtime, some glycerin or warm oil of sweet almonds, for the purpose of softening the wax as much as possible, and then, next morning, wash out the canal with plenty of warm water and a syringe, throwing in about twenty syringes full, or injecting in all one pint of tepid water, as advised in the removal of foreign bodies. It is a good plan, however, not to wash the ear too much at the first time, but to desist when some impression appears to have been made upon the hardened wax, and to resume the washing next day, repeating the operation as often as is necessary until the whole is removed. Sometimes the outer crust of the wax is so hard, that liquids make no impression on it. Under these circumstances, it is useful cautiously to drill a hole in the plug of wax by means of a sharp needle, Fig. 412, taking care not to use such pressure as might force the plug against the membrane of the tympanum. After the wax has been completely removed, the condition of the tube should be examined, and if it is found to be red and inflamed near the bottom, as it will often be, owing to the removal of the epidermis and the existence of an eczematous inflammation, it should be treated as similar inflammations elsewhere. Sometimes the condition of the auditory canal is such as to require the use of a weak solution of sulphate of zinc, of acetate of lead, half a grain to the ounce, or the nitrate of silver, one-fourth of a grain to the ounce, the surgeon being careful to apply these washes by moistening a small portion of charpie and allowing it to remain in contact with the diseased portion of the canal. When these liquids are injected, or poured into the ear, they necessarily come in contact with the membrana tympani, and may thus become a source of irritation. Having completed the application of the wash, a little carded wool should be temporarily kept in the orifice of the meatus. In a few days the disorder will be cured, after which the ears should be kept scrupulously clean, or if the accumulation of wax appears to depend upon increased activity of the ceruminous follicles, counter-irritation should be applied behind and beneath the auditory canal near the meatus.

§ 2.—Deafness from Dryness of the Ear.

Sometimes deafness is the result of excessive dryness of the external meatus and of the membrane of the tympanum, evidence of which is noted in a diminished secretion in the epithelial layer of the lining membrane.

Symptoms.—The general symtoms of this condition are, in connection with the function of hearing, similar to the symptoms produced by an accumulation of wax in the ear; thus there is the same dullness of hearing, and the same sensation of ringing and roaring in the ear.

Diagnosis.—A diagnosis may be made between these two conditions by means of a very simple test, as an examination with a speculum and a good light will at once show that the canal is free. Then, again, in most instances of deafness from dryness of the tympanum, the patient hears better when there is a good deal of noise. Thus a conversation which, under ordinary circumstances, would not be heard, will often be noted quite distinctly, when riding in an omnibus, or sitting in a mill, the noise of which would perhaps make the voice quite inaudible to a person with a perfectly healthy ear. This same peculiarity, here mentioned, is also found in what is called nervous deafness, a disease which is now believed to be much rarer than was generally supposed by the majority of the profession. A diagnosis of deafness from dryness, and that due to nervous disorder, may, however, be very readily made, from the fact that in deafness from dryness of the tympanum, the patient can often hear the ticking of a watch perfectly well if it is placed in his mouth, or against his mastoid cells; while in deafness from disease of the nerve this will not be the case. Dryness of the tympanum can also be recognized by means of the speculum, the membrane of the tympanum, which in health is translucent, being now observed to be whitish, opaque, and presenting more or less the appearance of damp parchment, although not quite so thick.

Prognosis.—The prognosis of the cure of deafness caused by deficient secretions in the canal and thickening of the drum should be guarded, much depending on the duration of the deafness, the age of the patient, etc. But not unfrequently a judicious and continuous treatment will, in a few weeks, render the improvement of the hearing quite evident, and these cases are often susceptible of being improved.

Treatment.—The treatment of this form of deafness is based on the principles regulating that of deficiency of secretion elsewhere, the lining membrane of the canal and the membrana tympani being stimulated into activity by means of various irritants. During the interim the necessary moisture of the parts may, however, be temporarily restored by means of the oil of sweet almonds, or pure and fresh glycerin dropped into the ear, this being the best substance known for preserving moisture on a dry surface; but if this is not at hand, melted chicken-fat may be substituted. With a view of stimulating the part to an increased secretion, the nitrate of silver may be very properly employed, the solution being applied on the sides of the canal, or to the surface of the drum, with a camel's-hair pencil, the external meatus being first oiled to protect the skin from discoloration. The solution may be used in the proportion of from one to four grains to the ounce of water. External irritants may also be applied in the neighborhood of the ear, and are very useful, either directly in front of the meatus, or, still better, behind it, and over the mastoid cells. Among these we may employ blisters, or inflame the skin by means of adhesive plaster mixed with tartar emetic, or by tartar emetic ointment, or croton oil, or collodion containing cantharidin, or by blistering tissue, or by creosote painted on the integuments and the mastoid cells; the last-named remedy being generally preferable.

The popular plan of treatment, by warming salt upon a shovel and rubbing it while hot behind the ear, is not a bad one, as the salt acts like any other stimulant, and some patients find the sensations produced by it extremely agreeable. Or the external membrane of the tympanum may be painted with pure citrine ointment applied with a camel's-hair pencil, if the patient can bear it, or if not, by its being diluted with lard. At the same time, the general health should be attended to, the patient taking a foot-bath every two or three nights as a revulsive. When the membrane of the tympanum is thickened, as well as dried, the treatment should be precisely that which has been stated under the head of simple dryness, except that the stimulating washes which are introduced into the ear must now be carefully applied by the pencil or mop directly to the membrane of the tympanum. When this membrane has been thickened for a considerable length of time, benefit will be derived from the continued use of $\frac{1}{18}$th of a grain of the bichloride of mercury twice or thrice daily after meals. But when the disease resists the treatment stated, and we are satisfied that this dried and thickened membrane is the true cause of the patient's deafness, the operation of puncture of the membrane, as before alluded to, p. 212, may be advantageously resorted to.

Thickening of the Membrana Tympani.—As illustrative of the appearance and treatment of thickening of the membrane of the tympanum, Cowling* published a case of deafness, of at least four years' standing, due to a thickened state of the *cuticle* of the membrane of the tympanum, in which this membrane appeared convex instead of concave, was not sensitive to the touch of a probe, and was *white* and dry, there being no wax in the meatus.

His treatment consisted in the application, every second day, of ungt. oxyd. hyd., with a brush, to the membrane, after syringing previously. After two or three applications this was discontinued, and a solution of cupri sulph., grs. xxx to aquæ f℥ss, applied with a brush, instead—still syringing previously to each application. After continuing this treatment some weeks, the ear was daily syringed with warm water, and injected occasionally with a small quantity of a solution of argent. nit. grs. xx to aquæ f℥ss. After several applications of this, "a thick flaky exfoliation" came away from the membrane, when the nitrate of silver was stopped, and an ointment of the biniodide of mercury directed to be applied with a brush every second day. The secretion of wax was soon resumed, and the patient recovered perfectly.

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* New Orleans Med. and Surg. Journ., vol. xi. p. 463, 1855.

Duration of Treatment.—Four months.

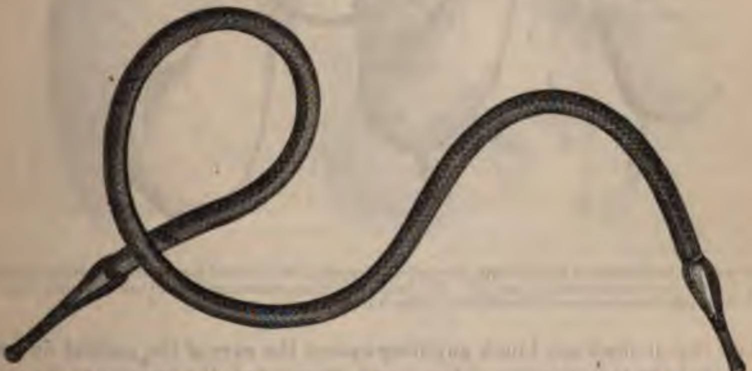
If no benefit is derived from this operation, the wound may then be allowed to heal, which it generally does very readily; but if the hearing is improved, a free crucial incision should be made, and the wound kept open by the occasional application of the nitrate of silver, until a permanent opening is established, which will permit the waves of sound to act directly on the internal ear.

§ 3.—Catarrhal Deafness.

Deafness may also be due to a *catarrhal inflammation* of the mucous membrane lining the internal ear; this having arisen either in the cavity of the tympanum, or had its origin in the throat and been transmitted to the cavity of the tympanum through the Eustachian tube.

Symptoms.—The symptoms, as might be expected from the seat of this disorder, are those simply of chronic internal otitis, already described, the inflammation being liable to result in internal suppuration and the destruction of the small bones of the ear. As the inflammation of the mucous lining of the Eustachian tube is usually accompanied by a serous infiltration of the submucous areolar tissue, a thickening follows, which diminishes the calibre of the tube, or causes such a fibrinous secretion as partially strictures it so that it will generally be found, at a very early period, that the patient is unable to blow air into the ear, and that the tick of a watch is not heard with distinctness, unless in contact with the cranium.

Fig. 420.



Toynbee's Otoscope. (From the instrument.)

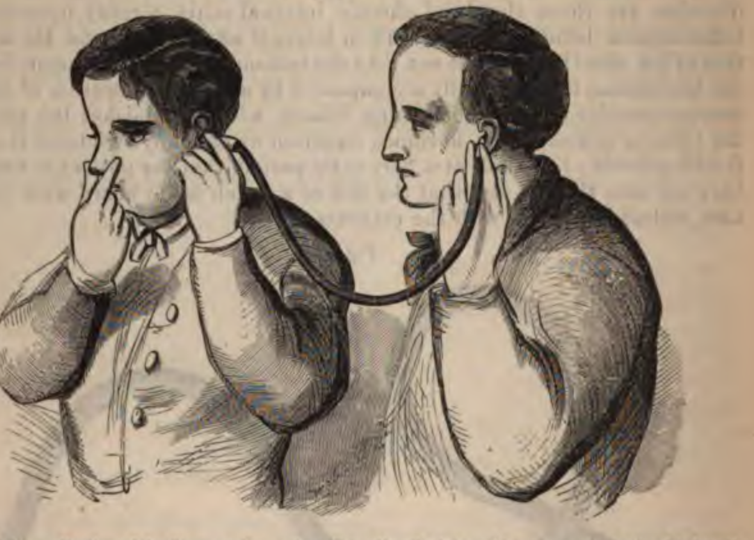
Diagnosis.—The sudden occurrence and history of catarrhal deafness, with the loss of the patulous condition of the Eustachian tube, and the existence of catarrhal and throat symptoms, render the diagnosis easy.

Prognosis.—The prognosis is usually favorable.

Treatment.—The treatment of this form of deafness is that of mild internal otitis, as already described. If the inflammation has originated in the pharynx, and that structure is yet in a state of chronic inflammation, as shown by its congestion, etc., the remedies should be addressed to the throat, by swabbing it out with a probang or sponge wet with a strong solution of the nitrate of silver, say thirty grains to the ounce. After which, the inflammation of the ear should be treated as was directed under the head of internal otitis.

Permanent obstruction of the Eustachian tube as a cause of deafness is, however, a much less common disorder than was formerly supposed, this tube being by no means so small or so easily obstructed as was at one time thought, while the angle at which it is placed, as well as the size of its orifice, favors the escape into the throat of any secretions of serum or mucus that may accumulate within it. Obstructions in the Eustachian tube may be tested by directing the patient to close the nose and mouth and making a full expiration, as already mentioned, so as to force the air from the pharynx into the ear. In order to judge of the effect of this self-inflation of the Eustachian tube, an "otoscope" has been proposed by Toynbee, consisting of a tube, the form of which is shown in Fig. 420. If the Eustachian tube is patulous, the drum will be acted on by the air forced into the cavity of the tympanum and rendered more convex, its vascularity being temporarily increased. Then, when the otoscope is held in the position represented in Fig. 421, care being taken that it shall not touch anything except the ears of the patient and surgeon, and the transmission of the sound interrupted, the bulging of the membrana tympani will be readily heard if the Eustachian tube is pervious. As catarrhal inflammation may extend to the membrana tympani, the condition of this membrane, and any change in its transparency, should always be carefully noted.

Fig. 421.



View of the application of the Otoscope, the patient distending the internal tympanum by forcing his breath into it as he closes his mouth and nostrils. The bulging of the membrana tympani can be plainly heard by the tube which enters the ear of the surgeon. (After Nature.)

§ 4.—Nervous Deafness.

Nervous Deafness, or that due to a paralysis of the auditory nerve, is a disorder often alluded to, though really a rare affection. It, however, sometimes occurs, and may arise from organic changes in the portio mollis, from tumors pressing upon the nerve, and from organic changes in the cerebral centres which may or may not result in paralysis. But it should be remembered that it is very seldom met with, and when it does exist, is generally coexistent with some other disease in the ear. When, however, true nervous deafness is present, very little can be done for the patient. Cases which appear to be due to mere paralysis of the portio mollis, in which there is no pain in the head, no cerebral disturbance, in which the existing condition appears to be a mere loss of power, and which sometimes suddenly ensue on the congestion induced by the too free or improper administration of the sulphate of quinia, may sometimes be benefited by transmitting a current of electricity through the ear, as hereafter directed.

Counter-irritants behind the ear or to the nucha may also be employed, and will sometimes prove useful. But before a case is pronounced to be one of nervous deafness, and before such measures as those suggested are adopted, a most careful examination should be made of both the external and the internal ear, to ascertain whether disease exists in them. If the patient can hear a watch tick when placed against his head, it may be safely asserted that some power yet exists in the nerves of the organ of hearing.

Kramer advises, in cases of paralysis or atrophy of the tensor tympani muscle, that magneto-electric currents should be applied by passing one electrode through the nostril or throat, near to the orifice of the Eustachian tube, and the other into the external meatus. Garratt,* of Boston, also recommends the application of the "**primary current of galvanism**," by a special method, in cases of paralysis of the auditory nerve. When the diagnosis can be certainly established, Kramer's plan might be usefully resorted to, but I have had no experience in it.

§ 5.—Deafness from Subacute and Chronic Myringitis.

Patients being entirely ignorant of the structure of the ear, and unable, as in inflammation of the eye, to note the redness, opacity, etc. of the drum of the ear, not unfrequently suffer from a subacute myringitis as the result of a so-called "earache," or external or internal otitis of a mild form; or, being relieved from an acute attack of myringitis, as caused in the manner before stated, continue to suffer from the changes of structure in the membrana tympani consequent on inflammation without consulting a surgeon, until deafness is well developed.

Symptoms.—Deafness as a consequence of subacute or chronic myringitis is usually accompanied by a sensation of stuffing in the ear, attended or not by tinnitus aurium. When the nose is blown, or air is forced into the Eustachian tube, the latter is found to be patulous, and the passage of the air "bursts something," or there is a sense of crackling. If one ear only is affected, the sensation differs in the affected ear from that on the sound side. Examination of the membrana tympani by the speculum and strong sunlight also shows a change in its character, the translucency and color being changed, the entire membrane presenting a dull-white, parchment-like hue, or opacity in spots, especially anterior to the malleus, like the opacities seen in the cornea in glaucoma. Should ulceration have existed, the opening in the tympanic membrane will be quite apparent, and the act of inflation through the Eustachian tube will cause the air to escape through the external meatus so as to act on the flame of a candle, if it is employed in the examination, or make a rushing sound that is quite perceptible as it escapes.

Diagnosis.—The diagnosis of deafness from this cause is not difficult, if the examination is carefully made and a full knowledge gained, by a comparison of the disordered with the healthy membrana tympani.

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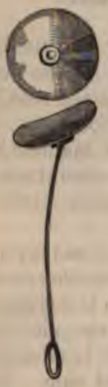
* Electro-Physiol., Boston, 1860.

Prognosis.—The prognosis should be guarded, especially in reference to the time required for the treatment. Subacute and chronic myringitis are both likely to be relieved if not cured, when they are seen early. But if of long standing, the opacity of the membrane of the tympanum is difficult to cure, though it may be much diminished, the hearing improving in a degree corresponding with the progress toward health.

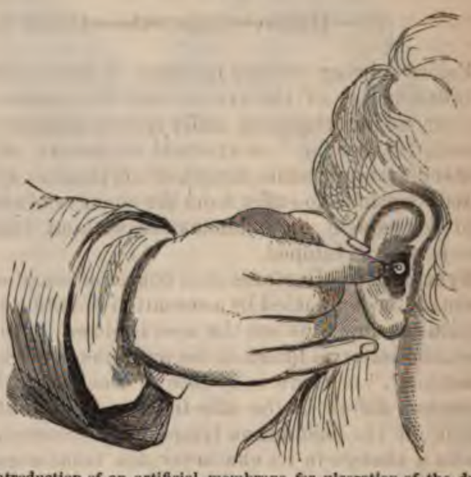
Treatment.—The treatment of deafness due to subacute myringitis consists in the local abstraction of blood by leeches, as directed in acute myringitis; in perseverance in purging, and especially in the administration of one-sixteenth of a grain of corrosive sublimate immediately after each meal, to act as a gentle stimulant of the secretions; in counter-irritation around the meatus, by the application of creosote every second or third night; by the continued nightly use of a stimulating foot-bath, and by such attention to the general health as the symptoms would indicate. When met with, as is often the case, as a sequel of otorrhœa in tuberculous children, or as the consequence of a syphilitic pharyngitis, remedies appropriate to these conditions of the system must be resorted to. In fact, a constitutional treatment adapted to a case of debility would be here equally useful—such as good diet, fresh air exercise, and chalybeates, with cod-liver oil, etc. When the membrane of the tympanum is destroyed, the ossicles will very frequently be found to have also been affected, especially in those cases consequent on an attack of measles or scarlatina. If the ossicles have not suffered from nercrosis or anchylosis, the simple ulceration of the tympanic membrane will not create positive deafness; the malleus and stapes being apparently acted on directly by the vibrating current of air. In these cases of perforation, Toynbee has highly recommended the application of a thin piece of caoutchouc as an artificial membrane, Fig. 422. This is to be introduced in the manner represented in Fig. 423. The introduction of a thin layer of wool, so as to close the orifice in the drum, has also been highly recommended by Toynbee; but I have never been able to obtain from either the benefit claimed by the advocates of each. The artificial membrane of Toynbee I have also found to be a source of irritation.

Fig. 422.



Toynbee's artificial membrana tympani. (From the instrument.)

Fig. 423.



Introduction of an artificial membrane for ulceration of the drum of the ear. (After Toynbee.)

It is in the deafness consequent on chronic myringitis—which is the condition often met with in old age, where the membrane of the tympanum often undergoes a fatty degeneration and opacity, like that seen in the arcus senilis—that the use of **ear trumpets and auricles** has been so much lauded. The use of a flexible tube to convey the rays of sound more directly to the drum is, in some cases, a source of comfort. The "auricles," or ear trumpets more permanently attached to the head, and lauded by various quacks as a "cure for deafness," are by no means superior to the flexible tube. They act, it is true, in collecting the sound, and thus are temporarily useful; but the constant presence of the tube in the ear often develops an irritation of the skin lining the cartilaginous canal, and thus keeps up an irritation that extends to the membrane of the tympanum and eventually does serious injury.

When chronic myringitis has left the membrane opaque, I have derived benefit from the application of local stimulants—as passing into the external ear, with a tube, the vapor of ether as it escapes from a bottle surrounded by a warm cloth, or the vapor of the red sulphuret of mercury heated beneath a funnel, so as to carry the vapor into the external meatus, for a few seconds.

The cold water douche on the side of the head and neck every day, for ten or twenty seconds, and gentle syringing of the ear daily, so as to stimulate the circulation of the membrane, combined with some of the means before mentioned, may also be employed.

"Scarpa's acoustic oil," "Harlem oil," and similar stimulants, are uncertain and dangerous articles, and had better be avoided.

Perforation of the drum, as hereafter described, has, in my experience, benefited cases of chronic myringitis with marked opacity and thickening of the membrane.

§ 6.—Perforation of the Membrane of the Tympanum.

Perforation of the Membrana Tympani as a cure for deafness was suggested by Sir A. Cooper, in 1800, in order to permit the entrance of air into the middle ear when the Eustachian tube was permanently closed, or when the membrane was too much thickened and changed to vibrate. Although a simple operation, it has not been much practiced, owing, apparently, to a want of confidence in its utility, or from fear lest injurious consequences should result. Such fears are, however, groundless; the puncture being readily made, not productive of great pain, and often healing with great facility.

Operation of Sir Astley Cooper.—After inclining the head, so that a strong light shall fall directly into the meatus, introduce a small trocar, or the instrument of Deleau, Plate XXIII. Fig. 19, or the knife of Horner, Plate XXIII. Fig. 17, at the anterior inferior side of the membrane, and transfix it so as to avoid the handle of the malleus.

Remarks.—In the rare cases in which the Eustachian tube is closed by mucus, and the surgeon finds it difficult to clear or dilate it by catheterism through the nostril, or when he wishes to assure himself positively that this tube is patulous, and cannot do so with the otoscope as before described, perforation of the membrane of the tympanum will enable him to act upon the cavity of the tube very advantageously, and to test with great certainty the condition of the inner portion of the ear, by forcing a current of air from a syringe through the meatus externus against the puncture in the membrana tympani. As the wound in the membrane will heal readily, the patient runs no risk of injury if the Eustachian tube prove to be totally impervious; while, if choked, it can be thoroughly cleansed by driving the mucus into the throat in the natural course of the tube. By thus demonstrating the pervious condition of the tube, the diagnosis of the character of the deafness will be much simplified.

Operation of Horner, of Philadelphia.—A method which Horner practiced on many occasions enabled him to pass a stream of water or air from the meatus externus into the throat, and thus clear the Eustachian tube more effectually than can possibly be done by means of a catheter passed into its orifice from the nose. It is accomplished as follows: Perforate the inferior half of the membrana tympani by a sabre-shaped knife, one line in breadth, the edge of which is on the convex margin, Plate XXIII. Fig. 17, by first plunging the cutting edge upward, and then revolving it on its axis, so as to make the incision either angularly or of the shape of a V, as this will leave a flap easily moved. A small pipe, surrounded by a cork, Plate XXIII. Fig. 21, being then introduced tightly into the meatus externus so as to plug it up, and a small syringe, holding an ounce and a half, being adapted to the pipe, the water may be forced through the hole pierced in the membrana tympani, as just directed, and thus pass into the internal ear and out of the pharyngeal orifice of the tube. The stream thus carefully thrown in will now be found to wash out the tympanum and Eustachian tube with great facility, as may be readily ascertained by seeing the water escape from the throat or nose. The air douche may also be most perfectly accomplished in the same manner; in any other way it is very defective, and not to be relied on for what it professes to do, viz., to open the Eustachian tube, as a very little reflection will prove. For example, let the same cork be fitted into a phial, and then let the operator try to inject air from the syringe into the bottle, and he will have a representation of the real effect of the air douche by the catheter introduced into the Eustachian tube from the nostril, as usually practiced.

Remarks.—Though Horner often performed this operation, he never knew it to do harm, but has, on the contrary, known it to do good. The principal idea of the profession, at one time, in regard to the cause of deafness, was, as evolved by the assertions of leading aurists, the fact of there being an obstruction of the Eustachian tube. This Horner proved to be an error, the obstruction of this tube being, in his experience, very unusual as a simple form of disease. I can also add the personal experience of numerous cases in support of this opinion.

In the air douche, by the catheter passed into the Eustachian tube, as usually advised, the introduction of the air may be regulated by a column of water acting on a large reservoir of air, or by means of the cock in the canister, Plate XXIII. Fig. 23, or by simply resorting to the caoutchouc bottle, Plate XXIII. Fig. 22.

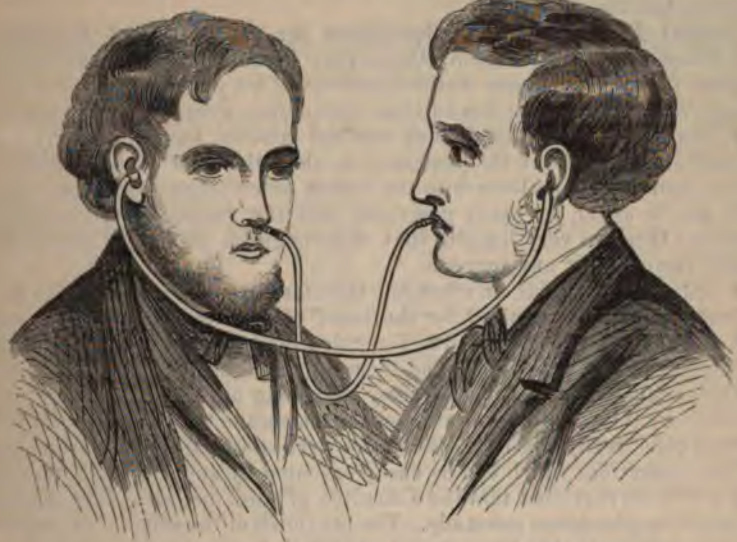
§ 7.—Catheterism of the Eustachian Tube.

When the position of the orifice of the tube in the pharynx is recollected, Plate XXVIII. Fig. 1, it will be seen that the introduction of the ear catheter through the nostril and pharynx is also a simple operation, though the verbiage in which it has often been described tends to create a belief in its being difficult. Aurists have recommended various instruments for the performance of this operation, and the catheters most in repute are those figured in Plate XXIII. Figs. 12, 13.

Ordinary Operation.—The patient being seated, with the head slightly thrown backward and firmly supported, take the catheter in the right hand,

and, after oiling it, introduce it into the nostril on the side to be sounded. Then, keeping the point of the instrument upon the floor of the nostril, and

Fig. 424.



Inflation of the cavity of the tympanum by the breath of the operator; the tube being attached to the Eustachian catheter previously introduced into the nostril of the patient. (After Nature.)

its convexity upward and inclined against the septum narium, slide it backward until it reaches the soft palate, as may be readily told by the sense of touch, or by the patient making a slight gulp or effort to swallow. At this moment, turn the point of the catheter upward and outward by rotating it a quarter of a circle, and then, by a slight movement forward and backward, slip it into the orifice of the tube, when it will pass as easily as a catheter can be made to enter the bladder. The proper position of the instrument may be at once known by its steadiness, as well as by the sensation of the patient.

When it is desired to inject air or liquids through the instrument, compress the nostrils and catheter in the fingers of one hand, and employ the syringe or gum-elastic bottle with the other, or resort to a little wire spring, Plate XXVIII. Fig. 2, or to a frontlet, Plate XXVIII. Fig. 3.

The frontlet, forceps, air-drum, etc. will all be found useful in the operations of those who may wish to devote themselves specially to aural surgery; but, for the general operator, the instruments figured in Plates XXIII. and XXVIII., and the use of the tube inflated by the operator, as suggested by Toynbee, and represented in Fig. 424, will prove sufficient.

Cases of deafness have been occasionally met with in which the aurist has found it impossible to pass the catheter into the pharyngeal orifice of the ear, and the cause of the difficulty has been either unknown or undescribed, in consequence of the rarity of a *post-mortem* examination of this region.

Neill, of Philadelphia, has published* the results of several *post-mortem* examinations, in which he has noticed a peculiar condition of this orifice of the Eustachian tube, it being overhung at its superior and posterior border by a thickening and hypertrophy of the mucous membrane with enlarged follicles, which is doubtless the occasional cause of deafness. Neill thinks it probable that the enlargement of the tonsils, which have so frequently been supposed to be the cause of deafness, may be real, owing to the condition which he has thus described.

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* Medical Examiner, vol. ix. p. 626, 1853.

General Estimate of the Operations for the Relief of Deafness.— The almost universal necessity that exists in the United States for every surgeon to practice several distinct portions of his profession, as well as the absence of definite instruction in these complaints, usually noted in the ordinary courses of education in our medical schools, have, for many years, induced the majority of the profession to shun the treatment of aural complaints, and forced patients into the hands of empirics. All these operations are, however, so easily practiced, and the variety of the complaints requiring them so very limited, that this condition of things may now be readily remedied by any surgeon.

In order to prove this, an effort has therefore been made to describe all the ordinary operations required for the relief of deafness, as fully as is necessary, and if the reader follows the foregoing descriptions, in connection with the plates, he will, it is hoped, find them full enough for all general points of practice connected with aural surgery. Washing out the external and internal auditory tubes, with perforation of the membrana tympani, or perhaps the mastoid cells, really constitute the entire portion of aural operative surgery, and are operations which can be easily executed by any. I think, therefore, that it is to be regretted that the difficulties of aural operations are so greatly overrated by physicians generally. The prognosis of the complaints requiring these operations is, it is true, often doubtful, or decidedly unfavorable; yet it should be remembered that, even when unable to cure, a medical adviser may effect much good by assuring the patient of the impossibility of his being relieved, and every one should, therefore, gain such an amount of practical skill as will enable him to give an opinion. By washing out the meatus externus, and examining the condition of the membrane of the tympanum; by catheterizing the Eustachian tube, or by perforating the membranum tympani, and testing the permeability of the passage to the throat, as above described, much advantage will often be gained by the patient, while the profession will be able to rescue many persons from the hands of unprincipled men, who, in the majority of cases, only do them harm.

If the general practitioner would only give these cases the attention that they deserve, or place them in the hands of a judicious surgeon, he would do much to banish the wretched quackery in aural complaints now so often seen. When deafness cannot be cured by a scientific course of treatment, it becomes the duty of the practitioner to exert his influence in preventing the patient from wasting his time and money among charlatans, whether professing to cure by "Scarpa's acoustic oil," or by the magnetic, electropathic, or chronothermal plan of treatment.

AMERICAN PAPERS ON THE SURGICAL DISORDERS OF THE HEAD AND FACE.

ON TREPHINING AND INJURIES OF THE HEAD.

Fracture of the Skull and Wound of the Brain, (cured after the application of the Trephine,) by John Syng Dorsey, M.D. Philadelphia.—*Philadelphia Med. Museum*, vol. ii. p. 282. 1806.

Memoir on the Subsequent Treatment of Injuries of the Head, illustrated by Cases, by Valentine Mott, M.D. New York.—*Trans. of the Physio-Med. Soc. of N. Y.*, vol. i. p. 223. 1817.

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Fractured Skull, successfully Trephined, by Andrew Park, M.D. Eaton, Georgia.—*Phila. Journ. of Med. and Phys. Sci.*, vol. viii. 1824.

Epilepsy from Depressed Bone, cured by Trephining, by David L. Rogers, M.D. New York.—*N. Y. Med. and Phys. Journ.*, vol. v. p. 79. 1826.

Observations on Injuries of the Head, by Benjamin W. Dudley, M.D. Lexington.—*Transylvania Journ. of Med.*, vol. i. p. 9. 1828.

Case of Epilepsy, cured by Trephining, by James Guild, M.D. Alabama.—*Amer. Journ. Med. Sci.*, vol. iv. p. 96. 1829.

Chronic Injuries of the Brain, relieved by an Operation with the Trephine, by Wm. Judkins, M.D. Mount Pleasant, Ohio.—*Transylvania Med. Journ.*, vol. ii. p. 135. 1829.

Case in which the Osseous Disk, removed by a Trephine, was regenerated.—*Maryland Med. Recorder*, vol. i. p. 152. 1829.

Case of Hernia Cerebri, cured by Sponge Compress, by J. W. Heustis, M.D. Mobile.—*Am. Journ. Med. Sci.*, vol. iii. p. 349. 1829.

A Case of Depressed Fracture of the Cranium, successfully treated without resorting to the Trephine, by Thomas F. Dale, M.D. Pittsburg.—*North American Med. and Surg. Journal*, vol. x. p. 164. 1830.

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Use of the Trephine in Epilepsy, being the sixth successful case, by Benjamin W. Dudley, M.D. Lexington, Kentucky.—*Am. Journ. Med. Sci.*, vol. xi. p. 542. 1832.

Compound Camerated Fracture of the Cranium, successfully treated by the removal of three pieces of the external table of the Skull, by Paul F. Eve, M.D. Georgia.—*Am. Journ. Med. Sciences*, vol. xii. p. 549. 1833.

Exostosis of the Frontal Bone removed, by R. D. Mussey, M.D. New Hampshire.—*Amer. Journ. Med. Sci.*, vol. xxi. p. 377. 1837.

Epilepsy successfully treated by Trephining, by George Hayward, M.D. Boston.—*Am. Journ. Med. Sci.*, vol. xxii. p. 517. 1838.

Researches on Hernia Cerebri following Injuries of the Head. Essay, read before N. Y. Med. and Surg. Society, by Gurdon Buck, Jr., M.D. New York.—*N. Y. Journ. Med. and Surg.*, vol. iv. p. 348. 1840.

Cases of Injury of the Head, by A. B. Shipman, M.D. Cortland County, New York.—*Am. Journ. Med. Sci.*, vol. ii. N. S. p. 66. 1841.

Cases of Injury of the Head, by A. B. Shipman, M.D.—*Am. Journ. Med. Sci.*, vol. ii. N. S. p. 373. 1841.

Operation for the removal of a large bony Tumor, called Spina Ventosa, by George M'Clellan, M.D. Philadelphia.—*Medical Examiner*, vol. iv. p. 44. 1841.

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Fall from a Height of Fifty Feet, without serious Injury, by L. A. Dugas, M.D. Georgia.—*Southern Med. and Surg. Journ.*, vol. vii. N. S. p. 271. 1851.

Fall from a Height of Twelve Feet, producing excessive Concussion of Brain, by L. A. Dugas, M.D. Georgia.—*Southern Med. and Surg. Journ.*, vol. vii. N. S. p. 271. 1851.

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Case of Fracture of the Cranium, with Depression, followed by Traumatic Tetanus, in which Trephining was successfully practiced, by E. Geddings, M.D. Charleston.—*Charleston Med. Jour.*, vol. vii. p. 505. 1852.

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Remarks on Fracture of the Cranium, (6 cases, showing results of Trephining,) by John Harden, M.D. Louisville, Ky. —*Western Journ. Med. and Surg.*, vol. ix. 3d S. p. 203. 1852.

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PART XIII.

DISORDERS OF, AND OPERATIONS ON, THE NECK AND TRUNK.

CHAPTER I.

SURGICAL ANATOMY OF THE NECK.

THE **Neck** is that region of the body which is situated between the head and the trunk, being bounded above by the base of the jaw, mastoid portion of the temporal bone, and occipital part of the skull, and below by the clavicles, sternum, and scapulæ. In its general outline, this region is cylindrical or cylindroid, with the base upon the shoulders. On the front and sides it is decidedly convex, presenting certain well-marked prominences, which, by establishing fixed points of reference, are highly useful to the surgeon. On its posterior face it is flat and regular, presenting nothing demanding special notice.

The prominences and depressions seen on the front of a well-formed neck indicate the position of certain important organs which are often objects of solicitude to an operator. Thus immediately above the sternum, in the median line of the neck, is a depression called the **supra-sternal fossa,** near or in which are usually found the roots of the large blood-vessels directly connected with the heart as well as several important nerves. Above this, in the median line, is the prominence caused by the larynx and trachea; and a little outwardly on each side of this line may be seen the elevation caused by the sterno-cleido-mastoid muscle. In front of this muscle, or between it and the trachea, is the **carotid fossa** or depression, where, from the superficial position of the vessel, its pulsations may be readily felt. At the base of the neck, near the clavicles and exterior to the sterno-cleido-mastoid muscle, is the **supra-clavicular depression** or **fossa,** containing part of the subclavian artery and vein, together with some other vessels of importance; and at its upper portion, in the space adjoining the base of the jaw, are the parotid and supra-hyoid regions, which contain several important parts that will be hereafter referred to more in detail.

The cylindrical shape of the neck, and the enlargement at its base, render the smooth application of a broad bandage around it nearly impossible, and it will hence be generally found necessary either to make all such pieces of dressing quite narrow, or to give them a curved shape on the lower edge like that seen in the stocks worn by men as an article of dress, in order to enable them to fit the clavicular portion of this region. A similar shape will also be requisite to adapt them to the upper and lateral parts of the neck, and especially to the outline of the chin and sides of the jaw.

Owing to the great importance of the various organs contained within the neck, and the necessity of an accurate knowledge of their relations to each other, it has been found advantageous to divide it into numerous sections or departments, either by imaginary lines or by following the course of well-known muscles. Each of these sections demands special attention, the advantages of such a subdivision being found in the facility as well as accuracy with which the position of the contents may be recognized. Of the various regions thus created by anatomists, none seems to me to present points of greater practical utility than that employed by Blandin, in his *Anatomie Topographique*, and the following descriptions will, therefore, be based mainly on the accounts furnished by him. In mapping out the regions of the neck, Blandin has divided its anterior or **Tracheal** surface into those parts which are above and those below the os hyoides, and into such as are more or less closely connected with the course of the sterno-cleido-mastoid muscle. Of the portion above the os hyoides, he makes two regions, one of the **Supra-Hyoid** or **Hyo-glossal** region, being the portion near the chin, and the other that about the parotid gland or the parotid region. The parts below the os hyoides, on the front of the neck, he divides into the **Laryngo-Tracheal** and the **Supra-Sternal regions,** while those on the sides are designated as the **Sterno-Mastoid, Carotid,** and **Supra-Clavicular regions.** The boundaries of these regions being, however, purely conventional, we find that in mapping them out there is some difference in the descriptions of different writers.

By some of the English anatomists* the disposition has been shown to apportion the neck into regions of a more mathematical character than those adopted by Blandin. Thus, on the neck being extended, one-half of it is made to take the form of an elongated square, which square is divided by the course of the sterno-cleido-mastoid muscle into two triangles, one near the clavicle and the other near the jaw, in both of which are parts of vital importance. But though upon the subject such a formation of regions may answer the descriptive purposes of the anatomist, it will not prove as useful to the surgeon as that adopted in the following pages, from the fact that any difference in the extension of the neck must cause the diagonal line to vary, and thus render the relations of the various parts incorrect, unless the utmost possible tension of the muscle is always obtained. As considerable experience has satisfied me of the practical utility of the system adopted by Blandin, it is recommended to the study of those who desire to obtain such a minute knowledge of this important section of the body as will fit them for the duties of the operator.

SECTION I.

THE SUPRA-HYOID OR GLOSSO-HYOID REGION OF THE NECK.

The **Glosso-hyoid** portion of the neck is bounded above by the inferior part of the tongue or base of the lower jaw; below, by the os hyoides; and laterally by a line drawn from the angle of the jaw to the extremity of the greater cornu of the hyoid bone, or by the expansion of that process of the fascia superficialis cervicis which is attached to the stylo-maxillary ligament and angle of the jaw, Plate XXIX. Fig. 1. The skin of this part presents nothing requiring special description. Its muscles consist of a portion of the platysma-myodes, of the anterior belly of the digastric, of the mylo-hyoid, genio-hyo-glossus, hyo-glossus, and a part of the stylo-glossus, all covered by a fibrinous expansion or fascia. This fascia—being the second tegumentary covering of the neck, as of several other portions of the body—is attached in this region to the os hyoides and base of the jaw. It sends a triangular process over the muscles at this part, surrounds the submaxillary gland, and then, by attaching itself to the stylo-maxillary ligament and angle of the jaw, places the submaxillary gland in a kind of pouch, which separates it by a perfect septum from the anterior and inferior portion of the parotid gland, Plate XXIX. Fig. 1. This reflection of the fascia superficialis and its attachment to the stylo-maxillary ligament is a valuable point of reference in operating on this and the adjacent regions. It also exercises a material influence on the disorders of the part, by preventing suppurations in the neighborhood of the parotid or submaxillary glands from communicating or traveling either forward or backward; it has also considerable influence on the development of tumors and their subsequent shape and condition.

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* Surgical Anatomy, by Joseph Maclise. Philadelphia, edit. 1851.

The principal **Arteries** found in this region are the facial, lingual, and sublingual, Plate XXIX. Fig. 5.

The **Veins** generally follow the course of the arteries, except the lingual vein, which, it should be remembered, is separated from its corresponding artery by the hyo-glossus muscle.

The **Nerves** are the hypo-glossal, lingual, glosso-pharyngeal, and their branches, Plate XXIX. Fig. 3.

SECTION II.

THE PAROTID REGION.

The **Parotid region** of the neck comprises its superior and lateral portions, and, though limited in extent, is of the highest importance to the surgeon. Bounded in front by the ramus of the inferior maxillary bone; behind, by the mastoid process of the temporal as well as by the meatus externus of the ear; above, by the zygomatic arch; below, by a horizontal line drawn a little below the level of the angle of the jaw; and within, or in its deeper points, by the styloid process of the temporal bone, as well as by the stylo-maxillary and stylo-hyoid ligaments; this region is closely circumscribed by dense tissues, and is generally accurately filled up by the parotid gland and its vessels. The muscles near the gland are the sterno-cleido-mastoid behind, to which, when enlarged, the posterior edge of the gland is often firmly attached, and the posterior belly of the digastric; the styloid muscles are within, or at the deepest side of the gland.

The **Parotid Gland,** in its normal condition, being seated between the angle of the jaw and the mastoid process of the temporal bone, is limited to these points; but, when diseased, will be found to encroach considerably upon the surrounding parts. Owing, however, to the expansion of the superficial fascia, and its attachment to the angle of the jaw, as before stated, the parotid is separated from the submaxillary gland, and cannot, therefore, extend itself to any great degree forward. The styloid process and ligaments limiting its deeper progress, and the sterno-mastoid muscle resisting its posterior development, nothing is left it but to enlarge outwardly or toward the skin; and, as its progress in this direction is resisted by the portion of the fascia superficialis, which covers it and forms its capsule, the engorgement of this gland generally causes severe pain by pressing on the neighboring nerves. The dense character of the fascia, and its strong adhesions around the gland,

PLATE XXIX.

THE SURGICAL ANATOMY OF THE NECK.

Fig. 1. A side view of the arrangement of the Fascia of the Neck. 1. Parotid gland. 2. Masseter muscle. 3. Submaxillary gland. 4. Os hyoides. 5. A portion of the fascia superficialis, dissected from the side of the face, and held down to show its relations to the stylo-maxillary ligament and angle of the jaw, together with the septum which separates the parotid from the submaxillary gland. 6. Deep process of the fascia superficialis which forms the septum just spoken of. 7. Internal jugular vein just beneath the angle of the jaw. 8. Deep cervical fascia. 9. Sterno-hyoid muscle partly displayed. *After Nature.*

Fig. 2. A view of the Superficial Vessels of the Neck. 1. Inferior maxillary bone. 2. Lingual artery. 3. Os hyoides. 4. Superior thyroid artery. 5. Descending branch. 6. Position of the carotid artery. 7. Sternal origin of the sterno-cleido-mastoid muscle. 8. Clavicle. 9. External jugular vein. 10. Its anterior branch. 11. Parotid gland and veins near the angle of jaw.

After Bernard and Huette.

Fig. 3. A view of the Deep-seated Parts of the Neck. 1. The œsophagus. 2. Omo-hyoid muscle. 3. Par vagum nerve. 4. Internal jugular vein. 5. Carotid artery. 6. Digastric tendon. 7. Hypo-glossal nerve. 8. Facial artery. 9. Facial vein. 10. Occipital and internal maxillary veins. 11. External carotid artery seen after the removal of the parotid gland. 12. Masseter muscle. 13. Pectoral muscle and clavicle. 14. Hook holding aside the external jugular vein.

After Bernard and Huette.

Fig. 4. A front view of the Veins of the Neck. 1, 1. Base of the lower jaw. 2. Os hyoides. 3, 3. Internal jugular vein. 4. Omo-hyoid muscle. 5. Larynx. 6. Sterno-hyoid and thyroid muscles. 7, 8. Superficial veins. 9. External jugular vein. 10. Sterno-cleido mastoid muscle. *After Bernard and Huette.*

Fig. 5. A side view of the œsophagus and adjacent parts. 1. Facial artery and vein passing on to the face. 2. Lingual artery. 3. Os hyoides. 4. Superior thyroid artery. 5. Œsophagus. 6. Trachea. 7. Inferior thyroid artery. 8. Sterno-cleido-mastoid, cut across. 9. Primitive carotid. 10. Internal jugular vein. 11. Upper portion of the sterno-cleido-mastoid muscle.

After Bernard and Huette.

Plate 29

Fig. 1

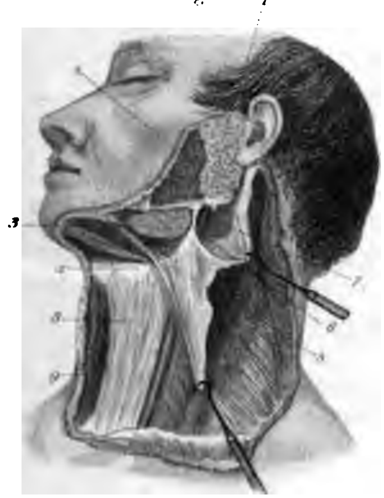


Fig. 3

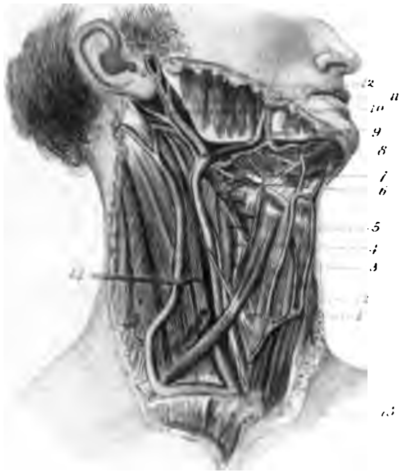


Fig. 2.

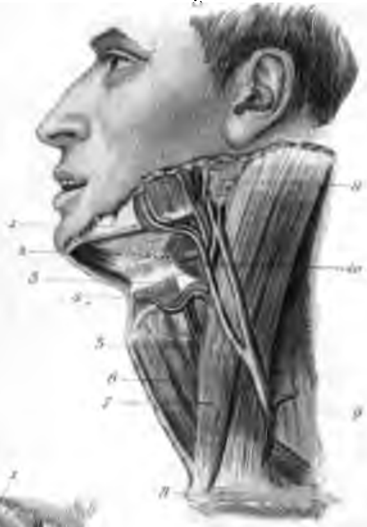


Fig. 4

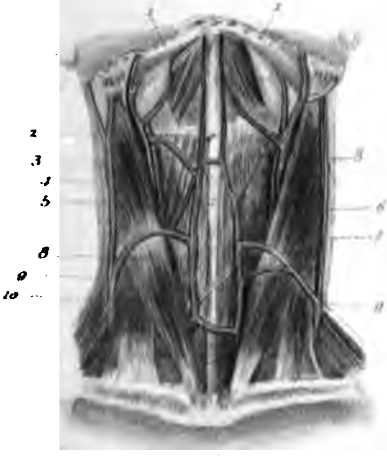
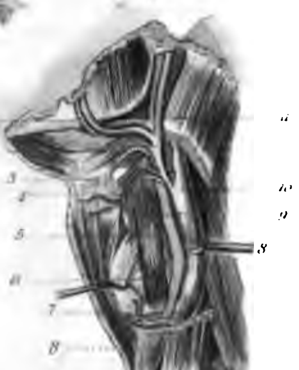


Fig. 5



have also an important influence upon the blood-vessels connected with it. In two cases which occurred under my observation, it led to the entire obliteration of the carotid artery, and in one, to that of the internal jugular vein, as well as the artery. When enlarged by scirrhus or similar deposits, the shape of parotid tumors is always at first more or less flattened in consequence of this expansion of the fascia over the surface of the gland, though ultimately they may attain considerable size and a globular form. Having no proper capsule, in the normal condition, the parotid gland owes its shape, and the continuity of its structure, to connective tissue, the induration of which, as well as its adhesion to the fascia just alluded to, renders the extirpation of the gland much more easy when diseased than it is in the healthy condition.

The **Arteries** of the parotid region are numerous, and among the most important of those found in the neck. The **External Carotid**, entering at the inferior and internal portion of the gland, passes through its substance not far from its internal or deeper-seated surface, and extends between the ramus of the jaw and the ear to near the level of the neck of the jaw-bone, when it gives off the internal maxillary and the temporal arteries. The **Internal Maxillary,** winding around the neck of the bone between the pterygoid muscles, is hence difficult to ligate, and sometimes gives rise to considerable recurrent hemorrhage, even after the application of a ligature to the external carotid of the same side, as I have seen in three instances. The **Veins** follow pretty generally the course and distribution of the arteries; but, owing to their direct connection with the internal jugular vein, caution is requisite in opening them, lest air be introduced into the latter vessel, whence it may readily pass to the heart and cause death.

The principal **Nerve** of this part is the portio dura, which, emerging at the stylo-mastoid foramen, penetrates the substance of the gland from above downward and forward. **Lymphatic glands** are also found, in considerable numbers, Plate XXXIII. Fig. 1, around as well as beneath the structure of the parotid, and the disease of these glands has occasionally rendered the diagnosis of tumors in the parotid region difficult, and led to mistakes in respect to the structure involved in the complaint.

SECTION III.

THE LARYNGO-TRACHEAL AND SUPRA-STERNAL REGIONS.

The middle of the front of the neck, presenting points directly connected with the trachea and larynx, has been named the **Tracheal** region, and is formed by that portion which is bounded laterally by the anterior edges of the sterno-mastoid muscles. The part of this surface above the os hyoides has already been spoken of as the supra-hyoid region. The region immediately below it constitutes the **Laryngo-Tracheal,** the lower portion of which, or that nearest the sternum, has been called the **Supra-Sternal** region.

The **Laryngo-Tracheal** region presents several useful points of reference, which are apparent outside of the skin. Thus, in passing from the os hyoides to the sternum in the median line, there is the prominence of the hyoid bone, the thyro-hyoid depression or space between the os hyoides and the thyroid cartilage, and indicated chiefly by the notch in the top of the cartilage. Next may be felt or seen the crico-thyroid space, the prominence caused by the development of the thyroid gland; then the rounded surface of the trachea; and, lastly, the supra-sternal fossa or depression, the depth of which is generally increased when the patient expands the chest, as in taking a full inspiration. On the external or lateral portions of the region, near the anterior edge of the sterno-mastoid muscles, may be felt the pulsations of the primitive carotid arteries; and this, as before stated, has led some anatomists to designate this portion of the neck as the **Carotid** region, instead of viewing it as merely the lateral boundary of the preceding part.

Examining the structures concerned in these portions of the neck, but little time need be given to the skin, which differs in nothing that is important from the same tissue elsewhere. Beneath it is seen the common Fascia Superficialis, and beneath this, but separated by sparse cellular substances, is the fascia known as the **Cervical Fascia** of Allan Burns, or the Fascia Profunda, a laminated expansion which exercises a most important influence on the diseases of this region. This fascia, arising from the larynx, forms a thin capsule to the thyroid gland, and, being then closely attached to the inferior margin of the gland, descends to the sternum in two laminæ, so as to form a perfect sheath for the sterno-hyoid and thyroid muscles. At its inferior extremity it is firmly attached to the sternum, sternal ends of the clavicles, and cartilages of the adjoining ribs, for about one inch below the upper edge of the breast-bone, thus forming an elastic and resisting membrane from the top of the sternum to the larynx. Directly above the sternum, it surrounds the arteria innominata and brachio-cephalic vein; and beneath it are the trachea, roots of the large arteries of the head and upper extremities, and the trunks of their veins, as well as important nerves.* Between these organs and the fascia there is much loose connective tissue filled with lymphatic glands, the former being liable to serous infiltration, and to extensive suppuration in the disorders of this and the adjacent portions of the neck. The external border of the fascia profundi colli is continuous with the sheath of the carotid arteries, while it and the fascia superficialis are united together along the anterior edge of the sterno-cleido-mastoid muscle.

The sterno-hyoid and thyroid muscles, on the median line of the neck, are the only muscles useful as points of reference in this region.

The **Arteries** are among the most important of the body. Counting from the sternum upward, we find the innominata passing obliquely from left to right, and from below upward. As it is only about eighteen lines in length, its position is limited chiefly to the supra-sternal fossa. Next to this may be mentioned the carotids which are in the lateral boundaries, and extend usually to a level with the os hyoides without giving off any branches; but, on reaching this level, they give origin to the two superior thyroid arteries. These, in connection with the two inferior arteries of the same name, run to supply the thyroid gland and adjoining parts, and are the only arteries which can be especially referred to as restricted to this region.

The accompanying **Veins** are very numerous, being both superficial and deep seated, and bring the blood from the thyroid gland and the surrounding organs into the jugular vein. The deep-seated veins have three principal directions: the superior follow the course of the superior thyroid arteries, and empty into the internal jugular vein; the middle come out at the sides of the thyroid gland, and also enter the internal jugular vein; but the sub or inferior thyroid pass down in numerous anastomoses toward the left subclavian vein, crossing the inferior portion of the trachea in an opposite course from that taken by the arteria innominata, and being also more superficial than this vessel, Plate XXIX. Fig. 4.

The superficial veins are more variable, and anastomose in various ways with the deep veins.†

The irregular size and direction of these veins render a minute and accurate description of them impossible, though their position in regard to the operations of tracheotomy and others practiced on this region would render it desirable. The surgeon should, therefore, be upon his guard, in all incisions made upon this part, and especially as he approaches the supra-sternal fossa. The relations of the veins and nerves connected with the course of the carotid artery, or those on the borders of this region, will be referred to hereafter.

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* Special Anatomy and Histology, by Wm. E. Horner, vol. i. p. 378, eighth edition.

† Bland, Anat. Topographique, p. 191.

The other tissues of this portion of the neck may be briefly mentioned at present in their relations to each other, as well as to those which surround them. Commencing with the skin, there may be noticed, first, a loose connective tissue, on which it moves readily; a layer of the superficial fascia; an anterior layer of the deep fascia, with some veins; the sterno-hyoid and thyroid muscles; a posterior lamina of the deep fascia; the thyroid gland, covered by each layer of this fascia, and thus placed in a capsule; the larynx and trachea, with the condensed connective tissue around them, which latter has been designated* as the tracheal fascia; then the œsophagus; and last the muscles on the front of the vertebræ. In this enumeration, no reference has been made to the great vessels and nerves of the neck, as their relations, variable disposition, and arrangement can be better understood in connection with the special operations practiced upon them.

SECTION IV.

THE SUPRA-CLAVICULAR REGION.

At the base of the neck, immediately above the clavicle, being bounded internally by the posterior edge of the sterno-mastoid muscle, and externally by the anterior borders of the trapezius and splenius muscles, is the region designated as the **Supra-clavicular.** Being triangular in its outline, with the base below, the clavicle, together with the trapezius and sterno-mastoid muscles, form its three sides. The skin and fascia covering this region, with a small portion of the platysma-myodes muscle, require little notice, as they present nothing of importance, and are chiefly noted by the surgeon as indicating the coverings that he may expect to find on tumors in this neighborhood. Of the numerous lymphatic glands situated about this part, some are superficial, and some deep seated, Plate XXXIII. Fig. 1, as in other regions of the neck. When enlarged, the movable character of the swelling, and its greater development when superficial, will generally enable an operator to tell whether the tumor is seated above or below the fascia, a matter of much importance to decide when extirpation is contemplated.

The **Arteries** usually found in the supra-clavicular region are such as supply the upper extremities and the adjacent parts of the neck. Among the first is the Subclavian artery, which, in the course taken from its origin to its escape through the subclavius muscle—whence to the edge of the axilla it is called axillary—forms a curve, the concavity of which surrounds the cul-de-sac made by the expansion of the pleura above the first rib.† The branches given off by the subclavian artery may be divided into those which run horizontally with, and those whose course is perpendicular to, the line of the clavicle, Plate XXXIII. Fig. 1. Among the first are the Posterior Cervical, which is two fingers'-breadth above the clavicle; the Superior-Scapular, which runs close along the posterior margin of the bone, and is often in the way of the operator in attempting to ligate the subclavian;

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* Porter, Surg. Anat. of Larynx and Trachea.

† Blandin, Anat. Topographique, p. 206.

PLATE XXX.

INSTRUMENTS EMPLOYED UPON THE ŒSOPHAGUS AND TRACHEA.

Fig. 1. Stomach-pump of Goddard. *Kolbè's pattern.*

Fig. 2. Physick's Œsophageal Catheter for the evacuation of the contents of the stomach. *Kolbè's pattern.*

Fig. 3. Ordinary Œsophageal Probang. *Kolbè's pattern.*

Fig. 4. Œsophageal Hook and Probang of Dupuytren. *Kolbè's pattern.*

Fig. 4′. Œsophageal Hook of Nathan Smith. *Kolbè's pattern.*

Fig. 5. Blunt Hook, made of annealed wire, for the removal of foreign bodies from the œsophagus. *After Bond.*

Fig. 6. Œsophageal Bougie for dilating stricture. *After Horner.*

Figs. 7, 8. Bond's Œsophageal Forceps. *After Bond.*

Fig. 9. Sponge for cauterizing the Larynx, as advised by Trousseau. *Kolbè's pattern.*

Fig. 10. Instrument employed by Green for the same purpose. *Kolbè's pattern.*

Fig. 11. Tongue Depressor; by which a patient can depress his own tongue without incommoding the operator. *Kolbè's pattern.*

Fig. 12. A ring made of watch-spring, so as to be readily adapted to any neck, and employed by the author to hold open the sides of the trachea after the operation of tracheotomy. *After Smith.*

Fig. 13. Ordinary tracheal tube or canula, intended to be placed in the trachea immediately after the operation of tracheotomy. *Kolbè's pattern.*

Plate 30

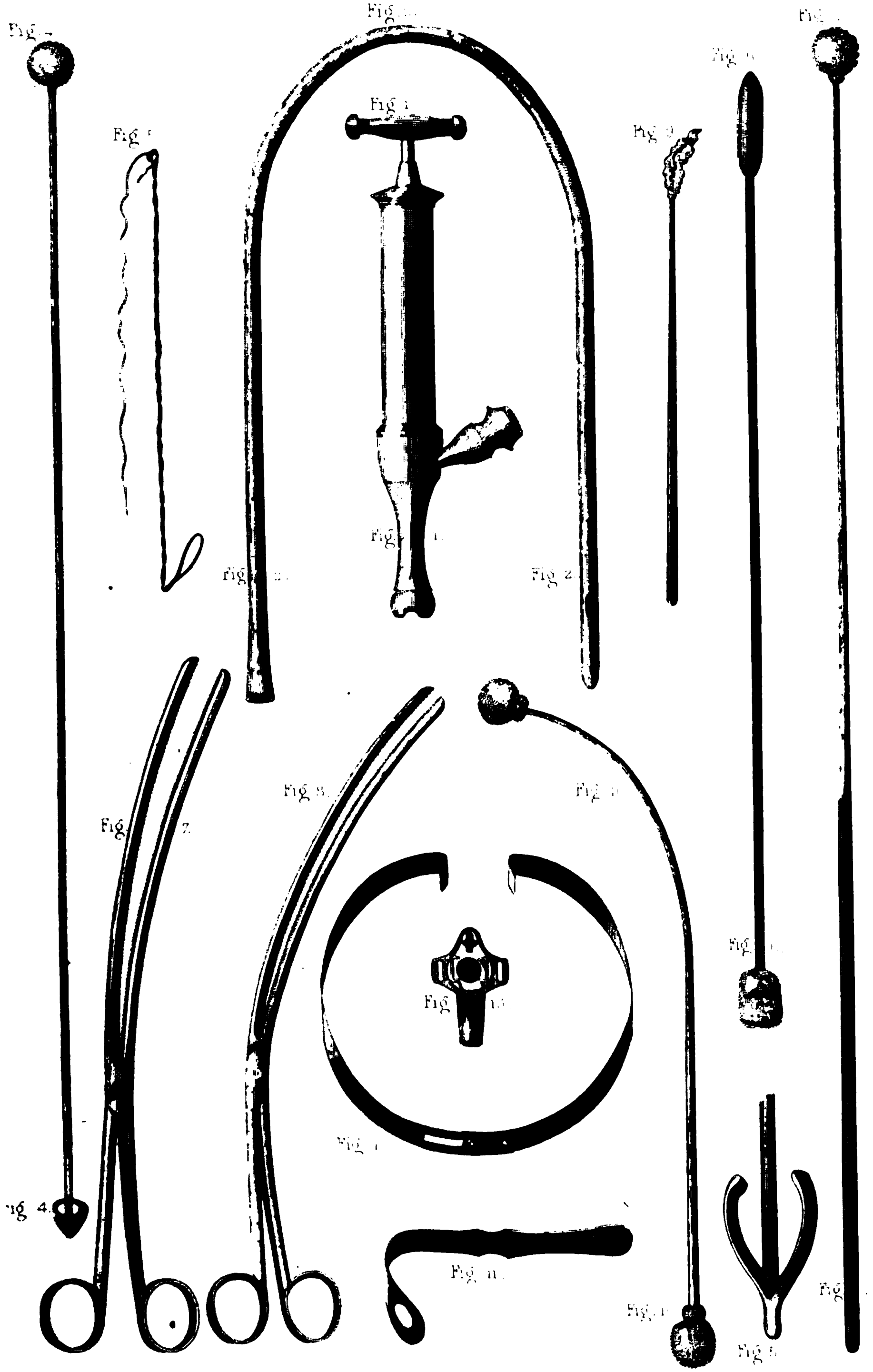
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Fig 5

and the Transversalis Colli, all of which run toward the back of the neck and top of the shoulder; while the Vertebral, Inferior Thyroid, and others, coming off within the scaleni muscles, run more or less perpendicularly. The perpendicular arteries, constituting the Thyroid Axis, arise at the inferior internal angle of this region, or at the space which exists between the sternal and clavicular origins of the sterno-cleido-mastoid muscle.

The **Veins** follow the course of the arteries, being generally in advance of them, or between them and the skin. The Subclavian Vein, however, does not pass between the scaleni muscles, but in front of them.

The External Jugular Vein terminates toward the inner side of the supra-clavicular fossa, after receiving the superficial veins from the shoulder, by emptying into the subclavian vein in front of the scalenus anticus muscle. Sometimes, instead of one trunk, there are two or three which unite at variable distances above the clavicle.

The **Nerves** of this region belong chiefly to the brachial plexus; the four lower cervical and the first dorsal nerves forming a plexus, which is more or less closely connected with the subclavian and the commencement of the axillary arteries, Plate XXXIII. Fig. 1.

The other details of these parts will be given in connection with the operations practiced on the artery.

In dissecting this region, the layers are usually presented as follows: First, the skin, then the superficial layer of the fascia, as well as the platysma-myodes muscle. Next, loose connective tissue, containing numerous venous and arterial branches, the principal of which have just been referred to as connected with the subclavian vessels. Around these vessels is a fibrinous expansion from the deep fascia, which forms for them a sheath, close to which is the cul-de-sac of the pleura, as it rises above the first rib. But the elevation or depression of the shoulder, by moving the inferior boundary of the region, will increase or diminish the apparent depth of these vessels, as well as relax or stretch the various layers which cover them.

CHAPTER II.

DISEASES OF, AND OPERATIONS ON, THE NECK ABOVE THE OS HYOIDES.

In the portion of the neck above the os hyoides we find two regions, the **Supra-hyoid** and **Parotid**, both of which may require surgical operations in order to relieve their different disorders. But as the importance of all the parts contained within the limits of the neck renders it difficult to make a selection of any one as specially worthy of attention, it has been deemed advisable to refer to these operations in the order which has been adopted as the plan of the work; and, commencing at the portion which is nearest the head, proceed from above downward, according to the natural arrangement of the tissues. The surgical affections of the skin and fascia in this section of the neck, presenting nothing requiring special operative interference, the disorders connected with the salivary glands become the first subject to which attention should now be directed.

SECTION I.

OF THE DISEASES OF THE PAROTID GLAND.

The diseases of the **Parotid Gland,** independently of the affections of its duct, of which mention has been already made in connection with the operations practiced on the face, consist either in such simple departures from a healthy state as yield readily to medical treatment, or in such degeneration of the connected tissue and proper structure of the gland as may necessitate its removal.

The position of several of the superficial lymphatic glands of the neck, and the enlargement consequent on their diseased condition, sometimes also creates such a tumor in the parotid region that any one who is not cautious in forming a diagnosis, or who does not accurately examine the anatomical relations of the surrounding structures, may readily be led to suppose the enlargement to be due to an affection of the parotid itself.

As caution is necessary in deciding on the structure involved in the tumors of this region, a guarded prognosis should always be given.

Pathology.—That the salivary glands, as a general rule, are less liable to abnormal deposits or to degeneration of structure than other glands, is a point on which most pathologists seem to agree. Velpeau* expresses the decided opinion that all malignant growths, when seated in the parotid or submaxillary gland, commence either by a deposit in the lymphatic glands incorporated with these glands, or by a change in the parenchyma of the glands themselves, rather than by a degeneration of the proper secretory portion. Whether this opinion is based upon microscopical examination, or is solely the result of close observation, it has a special value in connection with the question of the propriety of extirpating these glands when diseased, which should be noted; because, admitting that the deposit commences in the parenchyma of the gland, it is evident that it cannot long be limited to its original seat, but must encroach on the surrounding structure, so as either to cause its absorption or disintegration. In the case of parotid tumors, such a change must modify very materially the natural relations of the part, and marked departures from the normal condition may, therefore, be looked for when the removal of the diseased mass is attempted. Particles of a gland, which, in the original state, were separate and distinct, or very loosely attached, will often, when diseased, be found to be blended in one common mass; and portions which were deep seated and difficult of access in health, prove to be superficial, in consequence of their close and condensed union with tissues nearer to the surface. It has, therefore, been noticed that a diseased parotid is often surrounded with a dense capsule, formed chiefly at the expense of the adjacent connective tissue and fascia, while its conglomerate parts are so fused into one conglobate mass, that the deepest portion of the gland has been pried entirely out from the deep fossa around the styloid process by the attachment of the exterior of the tumor to the muscles and parts about the angle of the jaw, as I have seen in several instances of well-marked scirrhus. That surgeons have been misled in relation to the difficulties of the removal of the parotid, from comparing the operation in the diseased structure with that attempted on it in health, is certain; and daily experience is leading many to place confidence in the views of those operators of the eighteenth century who advocated the practicability of accomplishing by an operation the entire removal of a diseased parotid.

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* Méd. Opératoire, tome iii. p. 644.

When, therefore, circumstances induce the belief that the removal of the diseased structure can add to the patient's days, the operation should be performed, as the entire gland has been extirpated beyond all doubt; though it should be remembered, in cases of malignant degeneration, that the patient will only be subsequently placed in the same condition with those who submit to an operation for the removal of a scirrhus or encephaloid deposit elsewhere.

§ 1.—Extirpation of the Parotid Gland.

For many years, the removal of the parotid gland entire was a vexed question, the possibility of accomplishing it being denied by high authority, among whom were Boyer, Richerand, and others, who, though dead, seem yet to influence a few surgeons of the present day, there being some who continue to speak of the matter in terms of doubt, notwithstanding the most positive proofs of its feasibility and execution. Informed of the existence of these doubts, and yet fully aware of the error of those who entertained them, Geo. M'Clellan, of Philadelphia, exerted himself to prove that the extirpation of the parotid gland was not only justifiable, but also capable of being thoroughly accomplished; and to his skill and energy, more than to that of any other surgeon, is due, I think, the credit of having demonstrated the reasonable character of the attempt; while by recalling attention to the means of treatment advocated by Heister, Von Swieten, Garangeot, and others, who had preceded him, in Europe, he secured for the operation a degree of confidence which has since led to its more frequent performance.

Extirpation of the parotid gland was, however, an operation which had previously been frequently performed in the United States, being first done by Warren, of Boston, who, as early as 1798, removed the entire gland; in 1805, M'Clellan, of Franklin County, Pennsylvania, did the same thing; in 1808, it was also successfully performed by S. White, of Hudson, New York; and in 1811 and 1814, and again in 1841, Sweat, of Maine, successfully repeated it.

But though it is evident from these facts that the operation was well known to a few, it was not until the time of Geo. M'Clellan (1826) that it was generally regarded as feasible, and that the difficulties attendant on the entire removal of the gland in a diseased state were found to be much less than those experienced in accomplishing the same end when it was in a healthy condition. Since this period, the removal of the entire gland has been successfully accomplished in numerous instances.

Operation of George M'Clellan, of Philadelphia.—The patient, Dr. John Graham, at that time a student of medicine in Philadelphia, had a tumor in the parotid region, the removal of which had been attempted in Dublin, but desisted from, in consequence of the opinion of the surgeons engaged in it, that, as the parotid was involved, the attempt was unadvisable. M'Clellan, thinking otherwise, proceeded to the operation, February 27, 1826, as follows:—

Operation.—Two curvilinear incisions were made from a little above the zygoma to a point two and a half inches below the angle of the jaw, so as to include nearly the whole of the old cicatrix between them. After reflecting the integuments from the surface of the tumor, the dissection of the mass was continued down to the zygoma and masseter muscle in front, and to the cartilaginous tube of the ear and mastoid process behind. Being unable to dissect any further in these directions, progress was made beneath the tumor by burrowing under its lower edge. The posterior belly of the digastric muscle being then divided, the fingers passed readily under the whole body of the tumor, and an effort was made to wrench it from its bed, but without success. Before proceeding further, the trunk of the external carotid was insulated, just as it was entering the tumor together with the descending veins; and then, instead of cutting them across, they were torn out from the body of the tumor with the thumb and finger. An instantaneous gush of blood deluged the eyes and face of the operator; but, before a ligature could be placed around the vessels, the hemorrhage altogether ceased in consequence of the retraction and contraction of the lacerated vessels. After powerful and repeated efforts at wrenching, aided by an occasional use of the knife, to divide the strong bands of connective tissue, and some of the fibres of the styloid muscles which adhered to the tumor, the mass was elevated above the ramus of the jaw and the mastoid process. The trunk of the portio dura, which was very much enlarged, being then seen mounting over the posterior margin of the tumor to enter its substance, was divided, and the upper portion of the tumor separated from the zygoma by the scalpel, as the layers of fascia were too strong to be lacerated.

In this step, the main trunk of the temporal artery was necessarily cut, and a profuse hemorrhage coming from the recurrent circulation, a ligature was placed on the vessel, this being the only one which was ligated during the operation. The internal maxillary was not discovered, having probably been ruptured in the act of wrenching the deep-seated portion of the tumor from behind the angle and ramus of the jaw. After waiting some time to see if hemorrhage would occur, the edges of the wound were united by three stitches of the interrupted suture, in order to prevent their being reflected inward; adhesive strips, a compress and head bandage completing the dressing. The patient recovered, with less deformity than existed before the operation.* The gentleman is believed to be yet alive, and residing in the City of New York.†

Operation of Mott, of New York.—Determining to ligate the external carotid artery before attempting the dissection, the operation of Mott was commenced by an incision about three inches long, which was carried from the posterior angle of the lower jaw downward and inward, so as to lay bare the artery. Owing to the tumefaction, this vessel was found to be nearly three inches from the surface, and was tied immediately below the digastric muscle, or a little above the upper border of the thyroid cartilage.

An incision was next commenced above the jugum temporale, and carried downward in a semicircular direction, until it terminated upon the os occipitis, when the incision on the neck was extended upward to intersect the one over the tumor.

On detaching the integuments in the form of a double flap, the gland was found in a melanotic condition. In order to free it, the adipose and areolar tissue along the inner edge of the tumor was divided until the masseter was exposed. The finger being then introduced into the mouth and cut upon, in order to avoid the division of the buccal membrane, the tumor was separated for some distance from the masseter, to which it closely adhered, and then separated from the jugum, which had become carious from pressure. The mass was next dissected entirely free from the digastric and masseter muscles, as well as from the angle of the jaw; but, as the patient complained of excruciating torture when the tumor was raised from below upward, the dissection was continued from above downward, and the adhesions being separated, with a few rapid strokes of the knife, from the capsular ligament of the lower jaw, the bulk of the mass was removed. The portion filling up the space between the styloid and mastoid processes was then cautiously detached with the handle of the scalpel, and the portio dura rapidly divided. Several arteries were tied during the operation, and the trunk of the temporal yielded a profuse retrograde hemorrhage. After waiting to see if there should be further hemorrhage, the wound was dressed by sutures, adhesive strips, lint, a compress and bandage.*

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* New York Med. and Phys. Journ., vol. v p. 650.

† Principles and Practice of Surgery, by the late Geo. M'Clellan, M. D., edited by J. H. B. M'Clellan, M. D., p. 335, note.

At first the wound did well, the ligature on the carotid separating on the fourteenth day, but the disease promptly showed itself, and the patient died of constitutional disturbance on the fifty-fourth day after the operation.

Operation of Randolph, of Philadelphia.—The disease being seated in the left parotid gland, the head was inclined to the right side, and an incision made from the zygoma down to the edge of the sterno-cleido-mastoid muscle; a second one was then made at right angles to this, and the flaps dissected back. The facial artery being secured, an attempt was made to raise the lower edge of the tumor and to secure the carotid artery where it enters the gland; but this being very difficult, in consequence of the close adhesions, the tumor was dissected from its attachments, from above downward. In doing this, the temporal and internal maxillary arteries with some smaller ones were secured, and the deep dissection being continued, the carotid was divided with the last adhesions of the tumor, and instantly secured by Physick's needle and forceps. The internal jugular vein was also cut and secured at each end. The operation lasted fifty-nine minutes; but little blood was lost. Rhea Barton, Horner, Norris, Coates, and the author, who witnessed and assisted in the operation, all coincided in the opinion that the entire gland was extirpated.† Having subsequently had the charge of this patient, I am fully persuaded that Randolph succeeded in removing the entire gland.

The wound healed readily, and the patient left the hospital well; but about ten months subsequently I heard of his death from a return of the disease. The tumor is now in the Wistar and Horner Museum of the University of Pennsylvania.

Operation of Horner, of Philadelphia.—A crucial incision over the centre of the tumor being freely continued along the base of the jaw, so as to include some enlarged lymphatic glands, and also down the neck in the course of the carotid artery, the flaps were turned back and the fibres of the platysma-myodes and the fascia of the neck freely divided. Commencing behind, the tumor was then dissected from the anterior edge of the sterno-cleido-mastoid muscle, to which it closely adhered, and, by working gradually forward, the gland, which was surrounded by a firm capsule, was gradually freed from its posterior and inferior attachments. The primitive carotid artery being then fairly brought into view by the progress of the dissection, was found to have been so much involved in the disease as to show considerable thickening of its coats, having the appearance of the vessel when injected in the subject. A ligature was therefore placed around it, nearly on a level with the larynx, but not tied, the upper and anterior attachments of the tumor divided, the artery tied, and the tumor removed from its deep adhesions. These were by no means as close as in the healthy condition, the adhesion of the tumor to the angle of the jaw having caused the exit of the gland from its deepest points. The division of the internal maxillary giving rise to considerable hemorrhage, the internal and external carotids were also tied, lest, in their patulous condition, recurrent hemorrhage should ensue through them also. The submaxillary gland, and the lymphatics leading to and adhering to the thyroid gland, were also removed, leaving the deep-seated parts of this region perfectly exposed; but, on a close examination, it was impossible to find either the internal jugular vein, or the par vagum, of this side. The wound was then filled lightly with lint; the flaps closed by sutures, and covered with adhesive plaster, a compress, and bandage. On the eighth day all the ligatures separated spontaneously, and the patient started for his home six weeks after the operation.* When last heard from, the disease had returned and caused his death by exhaustion.

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* Am. Journ. Med. Sciences, vol. x. p. 17.

† Ibid., vol. xxiii. p. 517.

Statistics.—Of eleven cases in which the parotid gland was extirpated by M'Clellan, ten recovered from the operation, seven of whom were living in 1848, one died on the fourth day, from coma consequent on the ligation of the carotid artery, and one died three years subsequent to the operation.† Three cases have been operated on successfully by John C. Warren, of Boston; one by John H. B. M'Clellan, of Philadelphia, successfully, although the pneumogastric nerve was divided in the operation; and one each by Mott, Horner, Randolph, Nathan R. Smith, Wheeler, Shipman, Toland, Wedderburn, and J. Mason Warren. Three cases were also operated on by Bushe, of New York. The history of these cases is, however, too extended to permit more than a brief enumeration, though it is right to say that in all of them there was more or less of cancerous degeneration which had involved the entire structure, or which, if limited to the areolar tissue in the first instance, had produced such a change in the gland that the original growth could not be recognized. From the account of the operations furnished by Velpeau,‡ it appears that there are over thirty-five cases of this operation in which it was reported that the entire gland was extirpated; though he seems to doubt the fact, because of the rarity of degeneration of the salivary glands as a class. But this general statement, when met by the positive assertion of the diseased condition of the gland by surgeons and anatomists of good standing, and recognized as such even by Velpeau himself, only shows the diversity of sentiment that may arise, when surgeons have not seen the same cases. Walshe§ says, in speaking of this opinion, that "it is certain that scirrhus and encephaloid do occasionally originate in the parotid, and run their ordinary course."

As regards the possibility of accomplishing the extirpation of the entire parotid gland, there is, therefore, in my mind no doubt. The fact, however, is equally well established that the ultimate result to the patient in these tumors, where the tumor is of a cancerous character, will be found to correspond with the operations performed for the removal of malignant growths in other portions of the body.

Remarks on the Operation.—In the descriptions of the operative proceedings just referred to, we see several varieties, each of them being more or less modified by the peculiarities of the case. Certain general precepts may, however, be applied to every instance in which the removal of the gland may be deemed proper.

1st. All external incisions should be free enough, *at first*, to enable the operator to work readily around the tumor.

2d. The tumor should be first loosened at its posterior part, then at its superior and anterior borders, and lastly at its inferior.

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* Medical Examiner, vol. vii. N. S. p. 30, 1851.

† M'Clellan's Principles and Practice of Surgery, p. 332.

‡ Velpeau, Op. Surg., by Mott and Townsend, vol. iii. p. 443.

§ Walshe on Cancer, p. 267.

3d. The attachments of the tumor to surrounding parts should be stretched or torn as much as possible, instead of being dissected, as the laceration prevents hemorrhage.

4th. The edge of the scalpel should be directed toward the tumor as much as possible.

5th. The external carotid artery should be taken up, as nearly below the tumor as may be necessary, at the moment of removing the gland from its deepest and inferior connections.

The propriety of ligating, or even of passing a ligature around the primitive carotid previous to acting on the tumor, is a question that the majority of operators have decided in the negative; and when it is remembered that, in some instances, the external carotid alone is cut, while the internal remains uninjured, and that, in others, the compression of the surrounding structures by the diseased mass has caused great diminution of the calibre of the vessels, or even their obliteration, this decision seems to be based on sound principles. In three instances, it has been my duty to attend to the hemorrhage during this operation, and in all it was readily controlled by pressure upon the main trunk of the artery when the course of the dissection seemed likely to injure the external carotid, or by the direct application of the ligature to the divided end of the artery, when it was cut free from the tumor.

In the operation performed by Horner, and in that of John H. B. M'Clellan,* the internal jugular vein was entirely obliterated; and in the others that have fallen under my observation, the artery has either been much thickened in its coats or diminished in its calibre, the most troublesome hemorrhage having been that which arose from the recurrent circulation. The paralysis arising from division of the portio dura, in one case, was subsequently very much relieved, and in the others, during the short period when they were under my charge, did not produce as marked deformity as that created by the presence of the tumor. In a case reported by Warren, it had nearly disappeared a few months after the operation.† That the division of this nerve was the cause of the intense suffering described by some of the earlier operators, is a point on which every surgeon of the present day must have his doubts, the pain then noted being doubtless due to the division of the branches of the third branch of the fifth pair, or of the cervical nerves involved in the disease. Mott, of New York, yet advises‡ that the carotid should always be tied first. He also recommends that an incision should be made in a vertical direction over the tumor in the course of its long axis, and that another should cross this, but not at a right angle; and that, after dissecting back the flaps, the operator should begin the separation of the gland from below, and not from the zygomatic arch. In connection with this operation, as well as in others upon the neck, he also cautions the surgeon against the dangers of the entrance of air into veins that may be wounded, and especially the jugular vein.

In reviewing the opinions thus stated in relation to the performance of the operation of extirpating the parotid gland, it may, I think, be safely said that, though the operation is one which involves a high responsibility, it is yet one which every good anatomist may succeed in performing. But whether, after accomplishing this much, the patient will be benefited for any long period, is a point which the statistics of operations for malignant growths elsewhere alone can settle. Certain it is that the removal of the tumor has often relieved the individual of the distressing neuralgic pains and œsophageal difficulties under which he formerly labored; and, as an euthanasial measure, or one capable of prolonging life for even a limited period, its propriety should, therefore, be calmly considered in every case where its performance may be demanded. My individual opinion is favorable to it when other general or local means have failed to check the progress of the disease.

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* Principles and Practice of Surgery, p. 336.

† Warren on Tumors, p. 290.

‡ New York Register of Med., vol. i. No. x. p. 153.

§ 2.—Relief of Enlargement of the Parotid Gland by obstructing the circulation.

In order to avoid the necessity of resorting to extirpation of the parotid gland in cases of scirrhus, various other local means have been tried, as leeches, friction, blisters, electricity, iodine, and pressure, though the latter can only be applied very imperfectly. Such means can, however, only act as palliatives. A more certain method of checking the development of the tumor, or inducing atrophy of its structure, will be found in the interruption of the supply of blood through the nutrient vessels of the parts, by ligating the carotid artery. This operation has been successfully performed, in two cases, by Hosack, of New York, and, in a third, absorption had visibly commenced. In the first case, the patient was a woman, aged fifty-five years, the tumor of considerable size, and of three or four years' growth, and had been treated with iodine internally and externally for two months, without benefit. After ligating the vessel, the tumor not only disappeared, but left a depression of the same form as the gland in its natural state.

But, in estimating the value of this operation, one difficulty evidently exists, and that is the utter impossibility of deciding whether the tumor is formed by the parotid. In one of the cases reported by Hosack, the account certainly justifies us in doubting whether the tumor was a cancer of the parotid, as these tumors are seldom very large; while if it was of the size of the encephaloid degeneration it would hardly have taken three or four years to have developed itself without inducing the death of the patient. When the tumor is formed of the parotid, or even the adjoining lymphatics, there would also be great difficulty in preventing the return of the blood through the recurrent branches of the opposite side, even when the carotid was tied. As, under ordinary circumstances, any surgeon who could accomplish the ligation of the artery could also remove the tumor, and thus render the removal of the diseased structure certain; while under the use of anæsthetics he would cause his patient but little additional suffering, I should much prefer the chances of the extirpation in effecting a cure, or even temporary alleviation of suffering, to those presented in any other plan of treatment, except an appropriate constitutional one. When this had failed, I would certainly operate, if only to alleviate the patient's suffering, and enable him to obtain an easier death.

SECTION II.

OPERATIONS PRACTICED ON THE SUBMAXILLARY GLAND.

Owing to the remarks made in connection with the degenerations of the parotid gland, there is but little necessity to occupy much space in considering the disorders of this body. Like the parotid, the submaxillary gland is rarely or never the starting-point of malignant disease, while the lymphatics in its neighborhood are often involved. But, should circumstances induce the surgeon to attempt its excision, he may accomplish it by the following plan:—

Operation.—Direct the patient to shut the mouth and throw back the head, inclining it to the side opposite to that which is affected. Then, by any incision which is adapted to the size of the tumor, cut through the integuments, and dissect back the flaps thus created, so as to expose the disease. Applying two ligatures to the facial vein, and dividing the vessel between them, and also ligating the facial artery near its entrance into the gland, or near the jaw, pass a needle and ligature through the tumor, and forming a loop with the ligature, remove the needle. Then drawing upon the loop, either downward and backward while the dissection is prosecuted in front of the gland, or outward and upward when it is carried below and behind the gland, free the latter from its pouch, avoiding all injury to the surrounding parts, by directing the edge of the knife constantly toward the tumor, and keeping its adhesions upon the stretch, by drawing firmly on the loop of the ligature which was passed through it.

The other tumors of this region will be referred to in the chapter on diseases of the lymphatic glands of the neck.

CHAPTER III.

DISEASES OF, AND OPERATIONS PERFORMED ON, THE LARYNX AND TRACHEA.

THE operations practiced on this portion of the neck are cauterization of the larynx from the mouth, and the opening of the larynx or trachea, either for the removal of foreign bodies, or in cases of membranous croup.

SECTION I.

SURGICAL ANATOMY OF THE LARYNX AND TRACHEA.

The upper extremity of the **Trachea** or the **Larynx** is formed by five cartilages. These cartilages, of which the thyroid, cricoid, and epiglottis—Plate XXXI. Fig. 2—are the most important to the surgeon, as connected with the operations on this part, extend from immediately below the os hyoides and root of the tongue to the first ring of the trachea, being lined throughout by a mucous membrane, between which and the cartilaginous structure is a sparse cellular tissue, liable in certain forms of disease to dropsical or serous infiltration.

The **Trachea** is four or five inches long in its entire length, though not more than two and a half inches in the portion which is situated between the top of the sternum and the cricoid cartilage. It is about nine lines in diameter, and composed of sixteen or twenty distinct rings, each of which is deficient in the posterior third, being completed in this portion of the canal as well as united to each other by elastic ligamentous matter.

The structures covering the trachea are the skin, superficial fascia, sterno-hyoid and thyroid muscles, and deep cervical fascia, together with the thyroid gland, which latter, or rather its isthmus, sometimes extends as low as the fifth ring. Beneath these parts is the areolar tissue, immediately around the

PLATE XXXI.

A VIEW OF THE OPERATIONS PERFORMED ON THE TRACHEA.

Fig. 1. A front view of the Surgical Anatomy of the Trachea. 1. Os hyoides. 2. Thyroid cartilage. 3. Thyro-hyoid muscles. 4. Crico-thyroid muscles. 5. Thyroid gland and veins in front of crico-thyroid ligament. 6. Rings of the trachea. 7. Common carotid artery. 8. Superior thyroid arteries. 9. Inferior thyroid artery. 10. Carotid artery, as divided. 11. Outline of the top of the chest. 12. Innominata artery. 13. Inferior thyroid vein. 14. Transverse vein.

After Bernard and Huette.

Fig. 2. Relative position of the Larynx, Trachea, and Blood-vessels. 1. Os hyoides. 2. Thyro-hyoid ligament. 3. Thyroid cartilages. 4. Crico-thyroid ligament. 5. Cricoid cartilage. 6. Trachea. 7. Internal jugular vein. 8. Transverse vein. 9. End of inferior thyroid vein. 10. Veins.

After Bernard and Huette.

Fig. 3. Relative positions of the great vessels concerned in operations near the top of the sternum. 1, 1. Internal jugular vein. 2, 2. Subclavian veins. 3. Subclavian artery. 4. Transverse vein. 5. Inferior thyroid vein. 6. External jugular vein. 7. Arch of the aorta. 8, 8. Primitive carotids.

After Bernard and Huette.

Fig. 4. A view of the operation of Tracheotomy, as performed by Mr. Liston. 1. The tenaculum inserted into the trachea. 2. Position of the bistoury in incising the rings. 3. Line and termination of the external incision.

After Liston.

Fig. 5. Extraction of a foreign body by Tracheotomy, the head being thrown back and lowered, so as to facilitate the gravitation of the object. 1, 1. Blunt hooks holding open the wound. 2. Hand of the surgeon in the act of extracting the foreign body, by drawing it upward from the bronchia.

After Bourgery and Jacob.

Fig. 6. A front view of the position and mode of retaining a canula in the Trachea, as usually practiced. 1. The incision. 2, 2. A tape attached to the wings of the canula and passing around the neck. *After Bernard and Huette.*

Fig. 7. The appearance of the parts concerned in Edema of the Glottis. 1. The epiglottis cartilage, much swollen by serous infiltration of its submucous cellular tissue. *After Gurdon Buck, Jr.*

Fig. 8. The operation of scarifying the Glottis for the relief of Edema. 1. The forefinger in its position as a director. 2. The knife in the act of scarifying the part. *After Gurdon Buck, Jr.*

Plate 31.

Fig 1

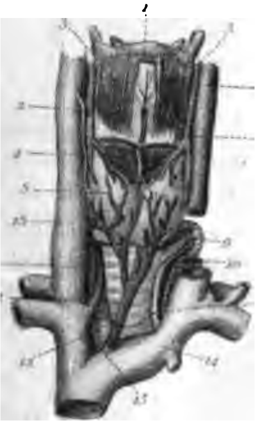


Fig. 2

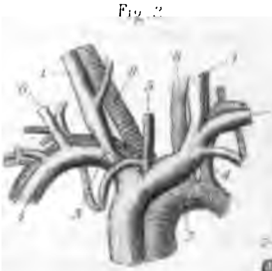


Fig 3

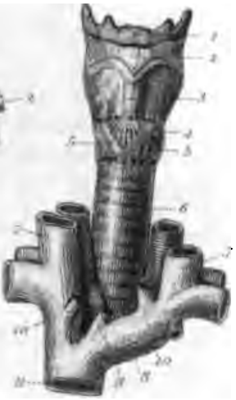


Fig 4

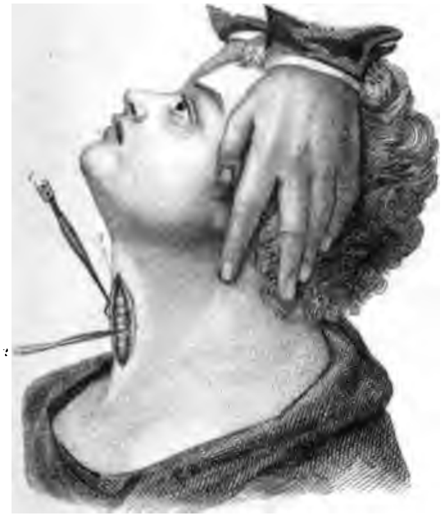


Fig 5

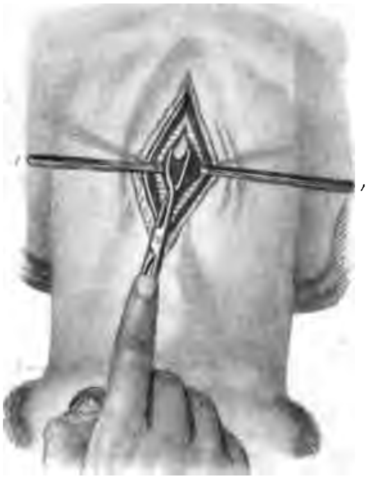
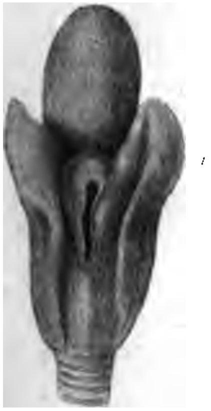


Fig 6



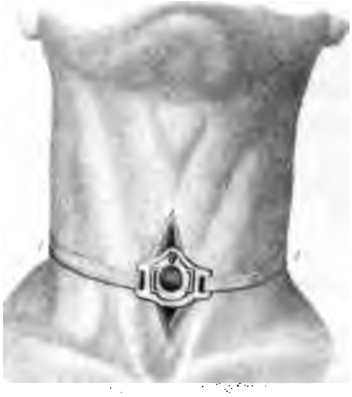
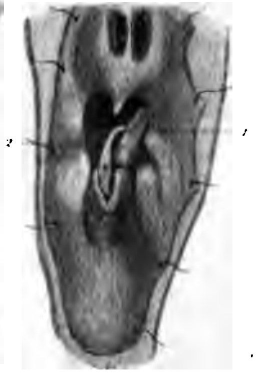


Fig 8



tube which has been spoken of by Porter as the **Tracheal Fascia**, and which is liable to become emphysematous when an opening is made into the trachea, unless it is specially attended to. But the most important of the surgical relations of this portion are the numerous blood-vessels, whose varying position renders them especially troublesome to the surgeon. Between the isthmus of the thyroid gland and the top of the sternum are usually seen several veins. Of these, the superficial veins are distributed on the front of the sterno-hyoid muscles, Plate XXIX. Fig. 4, and cause but little trouble in operating; but the plexus formed by the deep veins, and especially by the inferior thyroid, together with an artery, (middle thyroid,) all of which are behind the muscles, will often prove to be sources of trouble in tracheotomy.

There are also certain variations in the arrangement of the larger vessels of the neck which may embarrass the surgeon when operating on this part. Thus, the superior thyroid artery occasionally sends a large branch to the crico-thyroid ligament, and then turns down to supply the thyroid gland; sometimes the inferior thyroid arteries are given off by the primitive carotids on a level with the thyroid gland; or the left carotid may arise from the innominata and pass across the front of the trachea, as has been seen in several instances by Blandin.*

As the trachea follows the shape of the vertebral column, it is most superficial at its upper portion, where the vertebræ are convex in front, but becomes deeper as it approaches the chest, so that near the sternum it is over an inch beneath the integuments, or even more, in short, fat necks; while the changes produced by edema, congestion, and the other consequences of disease of the windpipe, especially in children, frequently add to the depth of this canal from the surface of the neck, at this point.

SECTION II.

DISORDERS OF, AND OPERATIONS ON, THE LARYNX.

The operations practiced on the **Larynx** consist in such as are required for the relief of the results of inflammation, and those demanded by the presence of foreign bodies.

Before deciding on the propriety of these operations, it will be well to employ the **Laryngoscope** as an additional means of investigation.

The Laryngoscope of Czermak consists of a large concave mirror of about eight to twelve inches focal distance, and three or four inches diameter, arranged with a central aperture on the well-known principle of the ophthalmoscope, which serves to reflect the light of an argand-burner, or gas-flame, upon a small metallic mirror attached to a long, flexible handle, which is introduced into the cavity of the pharynx, and held there at a proper angle. The flexibility of the handle allows of the adjustment of the mirror under different angles; and to avoid the condensation of vapor on its surface, it is previously gently heated in a lamp, or by dipping it into warm water. The image is observed through the central aperture in the concave mirror, which, if the operator desires to use his hand as a spatula, probang, etc., may be attached to a support of soft wood or orris-root, by which it may be held between the operator's teeth, and be furnished with screws for adjusting it in any position.

If the patient protrude the tongue as far as possible, the mirror can be readily held in the pharynx, the epiglottis will be lifted from the aperture of the glottis, and when the patient pronounces forcibly certain sounds, the chordæ vocales will be brought into full view. On pronouncing *a* long, (as in fate,) these will be seen to open, allowing the inspection of the parts beneath. With this instrument, after a little practice, there will be no trouble in bringing into view the back of the tongue, the epiglottis, the arytenoid cartilages, the true and false vocal chords, the ventriculus Morgagni, the anterior walls of the larynx and trachea, and even, though with greater difficulty, the bifurcation of the trachea.

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* Anat. Topograph. p. 196.

The instrument, in a slightly modified form, has also been used by Prof. Czermak for examining the posterior wall of the soft palate, the upper wall of the pharynx, the nasal cavities, and the orifice of the Eustachian tubes.

Stangenwald reports* that he has frequently used this instrument, in conjunction with Green, of New York, and with satisfactory results. It can be obtained at the cutlers.

§ 1.—Cauterization of the Larynx.

The cauterization of the larynx is an operation which may be demanded in the treatment of various forms of inflammation, and especially in membranous croup.

The credit of suggesting and applying this remedy is due to Trousseau, of Paris,† who first introduced a strong solution freely into the canal, both by means of a sponge as well as by a syringe; while in the United States particular attention has been called to the advantages of its employment by Green, of New York.‡ The operation is simple, and may be readily performed as follows:—

Operation.—Place the patient before a strong light, with the mouth widely opened, and the head supported, and, depressing the tongue by any means that is found most convenient, pass the sponge directly into the larynx, Plate XXXII. Fig. 2, on either side of the epiglottis, and immediately withdrawing it, much less inconvenience will be caused to the patient than might have been anticipated.

The instruments adapted to this purpose may be seen on reference to Plate XXX. Figs. 9, 10, 11, and include both those of Trousseau and Green, the difference between them not being very marked.

Remarks.—Cauterization of the larynx is an operation of so simple a character that reference to it in these pages might seem unnecessary, were it not that it is an important preliminary step in the treatment of croup, and one that should always be employed before tracheotomy is resorted to. Although this remedy had been known to the profession for several years, incredulity, and a knowledge of the irritation usually created by the presence of even a small particle of any substance in the trachea, prevented very many in this country from attempting it; and there are yet to be found practitioners who deny the possibility of introducing a sponge into the glottis. To Green, of New York, is therefore due the credit of having done more than any other surgeon in the United States toward establishing professional confidence in an operation which has since proved to be both easy and useful in many instances. The tendency to quackery, so often observed in the treatment of affections of the windpipe, dependent on chronic inflammation, has, however, shown itself in this as in other rational plans of treatment; and a measure which is capable of doing much good, when judiciously directed, seems likely to be underrated by many, on account of its liability to be misemployed.

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* The Laryngoscope of Prof. Czermak, by Hugo Stangenwald, M.D., (read before the New York Medico-Chirurgical College, June 14, 1858.) From the Southern Medical and Surgical Journal, vol. xvi. N. S. p. 871.

† Traité de la Phthisie Laryngée et des Maladies de la Voix. Paris, 1836. Mém. de l'Acad., etc.

‡ Diseases of the Air-passages. New York, 1846.

§ 2.—Edema of the Glottis.

Pathology.—In the rare form of disease of the upper extremity of the larynx, which has been designated as **Edema of the Glottis**, there is commonly found an infiltration of the submucous connective tissue of the aryteno-epiglottic cartilages, in consequence of the development of such a degree of inflammation as results either in the deposit of pure serum or of a gelatinous serum or lymph, or of pure pus, or of pus mixed with shreds of the membrane consequent on sloughing of the tissue, though this last condition is said to be rare. Owing to these changes, the mucous membrane lining the opening or edges of the cartilages at the top of the larynx becomes distended and formed into folds, or doublings, which, rising upward, and also extending downward as far as the vocal chords, Plate XXXI. Fig. 7, render the epiglottis thick and stiff, greatly diminishing, or even closing the opening of the larynx, so as to prevent the entrance of air into the lungs.

Originally named by Bayle, in 1808, Edema of the Glottis, this complaint has been described as if it were limited to that portion of the larynx which is anatomically described as the glottis, whereas it is really, as shown by Bouillaud and others, an edematous inflammation of the larynx itself, consequent on, or accompanied by, a similar condition of the surrounding parts. Though often the result of the extension of inflammation from the pharynx to the larynx, this complaint sometimes occurs spontaneously, three out of the forty cases reported by Valleix having suffered from it while otherwise in good health; it is also most common during the convalescence from slow fevers or after pneumonia. In most instances, however, it is the result of an inflammatory affection of the laryngo-pharyngeal membrane, where it is expanded over the tonsils, uvula, or soft palate, at which points the membrane is seen increased in color, and accompanied by all the symptoms consequent on tonsillitis, though at other times it is unnaturally pale and swollen in this affection. Such a condition of parts, it is now believed, existed in the case of General Washington, who, without presenting marked symptoms of croup, yet died asphyxiated. That the difficulty of respiration in his case was not alone due to the angina, must be admitted by all who recall the anatomical relations of the parts; and as edema of the glottis was not thoroughly understood at the period of his death, the explanation thus advanced is due to the observation of more modern pathologists, as may be seen by referring to the views of various writers on this subject.*

Sometimes edema of the glottis, instead of being an acute complaint, is merely a subacute affection, and is, therefore, difficult to recognize solely by inspection, in consequence of the natural appearance of such portions as can be discovered by the eye. Under these circumstances, the sense of touch should be most confided in, as it alone will often enable the surgeon to recognize the condition of the top of the larynx, and enable him correctly to appreciate the diminished state of an orifice which has sometimes been so completely closed as scarcely to permit the passage of light into the trachea, even when it was removed from the body. Edema of the Glottis appears to be much more common in males than in females, twenty-nine out of the forty reported by Valleix* being males, and only eleven females. Without referring to the medical treatment which would be proper as preliminary to, or as an adjuvant of, the operation demanded for its relief, and, with the simple mention of the utility of tracheotomy as a last resort, this account will be limited mainly to the operation, and especially to the means employed, with great success, in several cases, by Gurdon Buck, Jr., of New York.

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* See Cyclopædia Pract. Med., vol. iii., art. Laryngitis; Dict. des Sciences Médicales, tome xvii.; Pract. of Med., by George B. Wood, M.D., vol. i. p. 743.

Operation of Buck.—The patient being seated on a chair, with the head thrown back, and supported by an assistant, should be first directed to keep the mouth as wide open as possible, or if unable to do so, should have it kept open by means of a plug introduced between the molar teeth. The forefinger of the surgeon's left hand being then introduced at the right angle of the mouth, and passed down over the tongue till it encounters the epiglottis, the end of the finger may readily be made to overlap this cartilage by being carried above it, as there is usually no difficulty in drawing the epiglottis forward toward the root of the tongue. The finger thus serving as a guide, Plate XXXI. Fig. 8, a curved knife—Plate XXXV. Fig. 15—should be conducted along it, the concavity of the instrument being directed downward till its point reaches the finger nail. Then, by elevating the handle so as to depress the blade an inch or an inch and a half further, the cutting extremity will be placed in the glottis between its edges, when the instrument, being slightly rotated from one side to the other, so as to give it a cutting movement, may be made to incise the mucous membrane by withdrawing it from the larynx. After repeating this two or three times, on either side, without removing the finger, the margin of the epiglottis, and the swelling between it and the base of the tongue, as well as the margins of the larynx, will be freely scarified; or scissors curved flatwise—Plate XXXV. Fig. 16—may be used in the same manner. Though a disagreeable sense of suffocation and choking is at first caused by the operation, the patient soon recovers, and submits to a repetition of the incisions after a short interval. In all the cases operated on by Buck, the scarification was performed twice, and in some instances three times, the hemorrhage which followed it being encouraged by the use of warm gargles.†

Operation of Lisfranc.—The patient being placed in a similar position to that just referred to, a slightly curved bistoury with a long and narrow blade, guarded with lint to within one line of its point, should be held as a pen in the right hand. Then passing the first and second fingers of the left hand through the isthmus of the fauces to the edematous swelling, pass the bistoury flatwise on the fingers down to the part, and when it has reached the larynx, turn its edge upward and forward, elevating or depressing the handle so as to make gentle pressure with its point, and scarify the tissue, when a little pressure of the fingers will readily evacuate the serum.‡

In milder cases, resort may be had to the use of the nitrate of silver.

Cauterization.—Green, of New York, has obtained much success from cauterizing the parts with a strong solution of the crystals of the nitrate of silver, ℈ij or ʒi to ℥i of water, and applied by means of the probang, Plate XXX. Fig. 10. A weak solution, Green thinks, is injurious, five or ten grains to the ounce only tending to increase the inflammation. His treatment is as follows:—

Apply the sponge probang wet with the strong solution first to the pharynx and top of the epiglottis, and, after a delay of ten or fifteen minutes, apply it freely to the base of the epiglottis and over the edematous lips of the glottis. Repeat this application every hour or two according to the urgency of the disease and the effect produced by the operation, attempting each time to introduce the sponge into the glottis, which may be the more readily accomplished as the edema subsides.* Should this fail to arrest the disease, resort must be had to Tracheotomy.

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* Mém. de l'Acad. Royale de Méd., tome xi. p. 121.

† Transact. Amer. Med. Association, vol. i. p. 137.

‡ Malgaigne, Operat. Surg., Philad. edit., p. 369.

Statistics.—Of six cases reported by Lisfranc, five were cured. Of eight reported by Buck, all terminated favorably, though in one tracheotomy was also resorted to;† and in six additional cases reported lately‡ as occurring in the hands of Buck, or in that of other surgeons in New York, all were likewise cured. R. A. Kinlock, of Charleston, has also lately cured one case by scarification, making twenty cures out of twenty-one cases.

M. Sestier, in a recent number of the *Archives Générales*, gives the result of 168 cases, of which 127 died. In 132 cases the ordinary treatment was adopted, and of this number 104 died. In 36 cases the operation of bronchotomy was performed, and of these 13 recovered and 23 died.§

Remarks.—Previous to the year 1821, there seems to have been no operation practiced for the relief of this complaint excepting tracheotomy, though Marshall Hall had suggested the idea of scarification at that time. This suggestion was, however, generally discountenanced till Lisfranc, in 1823, resorted to punctures and pressure. His idea seems also to have been forgotten, or at least not generally resorted to, being viewed as a "fantastic operation," until Buck, of New York, called the attention of the surgeons of the United States to the result of his operations. When we recollect the serious nature of the complaint, and the fact that, without opening the trachea, the danger of death is imminent, the benefits conferred upon society by such a paper as that of Buck, cannot be too highly estimated.

Among many points, on which he lays especial stress, is the means of diagnosis previously pointed out by the French writers, and especially by Tuilier, who proposed it in 1815, in his inaugural thesis.‖ In seven cases out of the eight treated by Buck, there was ample evidence to the touch of the puffy condition of the parts, and in the eighth there was no proof that they were not swollen. Of seventeen other cases which Buck has collected, the edema was present in fifteen, giving in all of them the sensation of a soft pulpy structure. That a practice so long advised in severe cases of edema of the limbs, should not sooner have been resorted to in a similar condition of so important an organ as the larynx, can only be explained by the fact that the true nature of the disease has only been accurately known within the last fifty years. As a substitute for tracheotomy, and as a rational means of affording relief from a distressing and dangerous complaint, the operation of scarifying the glottis and epiglottis may be regarded as one of the most useful of those suggested by the surgeons of the nineteenth century.

Cauterization is only likely to prove useful in the earlier stages.

§ 3.—Polypi in the Larynx.

In a valuable monograph by Ehrman, of Strasburg,¶ professional attention has been called to the occasional presence of polypi upon the laryngeal mucous membrane, in which he describes minutely a series of symptoms that have, perhaps, been more frequently seen than recognized, as similar symptoms have sometimes been noted without the observer being able to recognize the lesion which occasioned them. Although alluded to once in the United States, by Cheeseman, of New York, in 1817,* few writers prior to 1850 seemed to have investigated this complaint as thoroughly as Ehrman, and the student will find in his work many practical details, which want of space compels me to pass, with only this brief allusion. As this account must be mainly limited to operative details, I shall only furnish a synopsis of a case reported by Green, of New York.† In this case, the polypus was removed by excision, though generally laryngotomy has been employed in consequence of the difficulty of obtaining access to the polypus through the glottis.

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* Surgical Treatment of Polypi of Larynx and Edema of Glottis, by Horace Green, A.M., M.D. New York, 1852.

† Transact. Amer. Med. Association, vol. iv. p. 277, 1852.

‡ Op. cit., p. 145.

§ Charleston Medical Journal, vol. viii. p. 97.

‖ Dict. des Science Méd., tome xvii.

¶ Histoire des Polypes du Larynx, 1850.

Operation of Green, of New York.—A young girl, ten years of age, after severe suffering, in connection with her trachea was found to have a white fibrous-looking polypus, the pedicle of which appeared to be attached to the left ventricle or left vocal ligament, as it could be seen when the tongue was firmly depressed and the patient coughed and gagged. This polypus being indubitably recognized, Green proceeded to excise it by seating the girl in a good light, with the head firmly held back by an assistant, while he depressed the tongue until the epiglottis was in view. Then, gliding a slender double hook down to the tumor, when raised by the patient's effort to cough, he fished it up, and after one or two attempts succeeded in slicing it off from its pedicle by cutting it from behind forward by means of a probe-pointed knife with a strong handle and a delicate slender blade. Some coughing followed, and a few drops of blood, but this soon passed away, and the young lady has for several years enjoyed excellent health.

Remarks.—In a paper by Gurdon Buck, Jr., of New York, read before the American Medical Association in 1853, and published in volume six of their *Transactions*, it is shown that the cases of pediculated polypi of the larynx similar to the above are very rare; but Buck, whose experience in this disease has probably been the most extended of any surgeon in the United States, regards the operation of Green as especially well calculated for their relief, and as highly creditable to the operator. In the majority of the cases the morbid growths are, however, more extended in their base, and seated lower in the larynx, requiring the performance of laryngotomy for their relief. The method of treating them will therefore be found in the account of this latter operation.

The prognosis of the disease when left to nature is almost always a fatal one, and the chances of an operation, except as a means of prolonging life, are also very slight, only two, that of Ehrman and that of Green, having recovered out of six who were subjected to an operation.

§ 4.—Tracheotomy.

The perforation of any portion of the trachea by means of a cutting instrument, with the view of affording a new passage for the entrance of air into the lungs, has long been designated as **Bronchotomy,** though, as the opening is limited to those portions of the trachea which are above the sternum, the term **Tracheotomy** is now more generally employed. Either may, however, be used to designate the operations practiced on the larynx or trachea proper, the incision of the larynx being most frequently spoken of as **Laryngotomy.** As the operation of opening the windpipe varies a little, according to the point operated on, the steps of each operation may be best described separately.

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* Transact. Physico-Med. Society, New York, vol. i. p. 413.

† On the Surgical Treatment of Polypi of the Larynx and Edema of the Glottis.

I.—Tracheotomy for Croup.—The operation of tracheotomy dates back to a very early period, Antyllus, A.D. 340, having recommended and performed it in several instances. It has also been performed at various times, and in different manners, solely in order to meet the peculiar views of the operator. To specify all these methods would, however, be a useless task, and I shall, therefore, limit myself to such a general plan of proceeding as may be advantageously resorted to under most of the circumstances which demand this operation.

Preliminary Measures.—When the operation has been decided on, prepare a sharp scalpel; two curved spatula or blunt hooks; a director; one straight, sharp, and one probe-pointed bistoury; dissecting forceps, and dressing forceps, if it is intended to remove a foreign body; a tenaculum or a pair of torsion forceps; sharp-pointed straight scissors; threaded needles; ligatures, and several small pieces of sponge attached to sticks or quills as handles, as well as one or two pieces of sponge, cold water, and towels, together with such other articles as may be demanded in the dressing.

Ordinary Operation.—Place the patient upon his back, with the head thrown sufficiently backward over a pillow, yet not so as to stretch it too much, or compress the trachea by contracting the muscles in front of it.

Then, while standing on the right side of the patient, let one assistant steady the head, Plate XXXI. Fig. 4, another confine the arms and steady the shoulders, a third attend to the lower limbs, and a fourth hand sponges, etc., as needed; or if the patient is a child, bind its arms to the body by inclosing them in a folded sheet or towel, so that one person may be able to hold it.

In commencing the operation, place the fingers of the left hand upon the skin near the median line, so as to steady it, and make an incision from the inferior part of the larynx down to near the top of the sternum, so as to cut only through the skin, or puncture a transverse fold of the skin when raised by the assistants, and cut from within outward; then, raising the fascia superficialis on the forceps, puncture and slit it upon a director to the full extent of the external wound. After finding the line of junction of the sterno-thyroid muscles, separate them with the handle or back of the knife, by tearing the connective tissue between them, and have them held back by curved spatulæ so as to expose the parts beneath, when the isthmus of the thyroid gland, if found to come so low down as to be in the way of the incision, should be tied by means of two ligatures passed beneath it by needles, after which it may be divided between the ligatures. At this time the venous hemorrhage from several points of the wound will often demand attention, and such vessels as can be seen should therefore be ligated. Then, pushing aside the two inferior thyroid veins, or ligating any anastomosing branches, or the middle thyroid artery if it exists, divide freely the condensed areolar tissue, which has been called by Porter* the Tracheal Fascia, and dissect a small portion of it from around the contemplated opening of the trachea, in order to prevent the parts from subsequently becoming emphysematous and closing the orifice. The trachea being now freely exposed, and the bleeding checked, a tenaculum may be inserted in the median line of the rings, Plate XXXI. Fig. 4, and the part thus raised excised by sharp-pointed scissors; or a bistoury may be at once passed in, and the trachea slit open from below upward, to the extent of three or four rings, not higher however than the second; after which, the wound may either be kept open by means of a dilator, as proposed by Trousseau, or by bending a piece of lead or pewter, so as to enable it to pass round the neck, and be attached to the sides of the wound, but not to the divided rings of the trachea, or by resorting to what I have found to be a neater instrument, viz., an elastic ring of broad watch-spring, which may be readily adapted to any neck simply by turning the pivot that holds the two halves together, Plate XXX. Fig. 12. The introduction of the old-fashioned canula into the trachea is, I think, so objectionable, that it may suffice at present simply to mention it, though, for the instruction of such as desire to employ it, I have added a figure to show how it is to be retained in the wound, Plate XXXI. Fig. 6. But whether the cartilages are trimmed so as to leave an opening, as advised by Lawrence and Porter, of England, or simply incised, the use of the blunt hooks or the watch-spring will always prove serviceable by keeping the soft parts from contracting and closing the orifice in the trachea, as is very apt to be the case when the rings are merely divided without excising any portion of them; but as soon as the parts are sufficiently retracted, which happens sometimes in thirty-six hours, the hooks or springs should be removed.

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* Surg. Anat. of Larynx and Trachea.

After-Treatment.—The operation having been promptly performed, the next most important point is the after-treatment, as on this depends the success of the operation. To one familiar with the pathology of croup, this will of course be simple, and may be summed up in the employment of such measures as would generally be useful in relieving inflammation of the throat. As it is, however, of importance that there should be no error on the part of the operator, I will briefly state the means that are most likely to contribute to the success of the operation. The wound should be lightly and carefully covered by a piece of moist gauze, so as to exclude dust from the tracheal mucous membrane. The temperature of the chamber should always be closely watched, and seldom permitted to sink below 80° Fahrenheit, as the air will now enter the lungs through the orifice in the trachea, without having been previously warmed in the mouth and nose. The atmosphere should also be kept moderately moist by a vessel of boiling water or vinegar and water so placed as to favor the evaporation of its contents. Then, if the trachea continues to be filled with the false membrane usually seen in membranous croup, it may be lightly touched *once*, with a camel-hair pencil wet with a solution of the nitrate of silver, ℈j to ℥j, introduced into the trachea through the wound. The frequent resort to this solution after the operation, though once practiced, is now seldom employed, as Trousseau has lately discountenanced it. When the edges of the wound and the trachea become dry and disposed to crusts, it will be found useful and agreeable to the patient to paint both surfaces with glycerin and water, the constitutional treatment being as carefully pursued as it would have been before the operation was performed. After the disordered action within the trachea has been arrested, the wound may be gradually approximated and union favored by the use of the warm water-dressing. The tracheal fistula sometimes seen may often be induced to heal by touching it daily with the solid nitrate of silver, or a resort to a plastic operation may be required. The object of the direct or surgical treatment of croup, it should be remembered, is merely to gain time for the efforts of nature to effect the cure, the life of the patient and the success of the operation being almost entirely dependent upon the remedial measures otherwise employed.

II. **Tracheotomy for the Removal of a Foreign Body.**—The performance of tracheotomy, for the removal of a foreign body, differs in no way from the operation just referred to in connection with croup; but the following plan, being presented as applicable to a case of this kind, and showing the results of a prompt incision into the trachea with the view of checking venous hemorrhage, is related in order to enable an operator to make a selection. The chief difference between this and the preceding operation will be found in the fact that it is not proper to delay opening the trachea until the hemorrhage is arrested, as was previously advised.

Operation of Liston.—In a patient, five years old, who had swallowed a small glass seal, the operation of tracheotomy was performed by Liston as follows:—

The patient, being securely fastened by a large sheet, wrapped several times round the body and arms, and closely pinned, was held by an assistant horizontally with his face upward, and his head between the operator's knees. The preliminary incisions being made as usual, the blood gushed out freely from the veins, which were greatly distended by the efforts of the child and the difficulty of breathing, but none of these were tied. After waiting a few seconds till the first rush of blood had somewhat abated, the trachea, which was never still for a moment, rising and falling rapidly with the hurried movements of respiration, was seized by means of a small hook, and drawn forward toward the mouth of the wound, Plate XXXI. Fig. 4. The scalpel being then entered at the lower extremity of the incision, with its point directed upward and its back toward the vertebral column, with the handle kept low, and with a light hold of the instrument, so as to avoid injuring the œsophagus by any sudden movement of the patient, two or three of the rings were divided, and the assistant immediately directed to turn the child over with his face downward. For an instant, the little patient seemed on the point of suffocation, as the first inspiration drew in a certain quantity of blood, which could not be prevented from flowing; but the next moment, by the change of position, the blood trickled on the floor, a deeper inspiration was taken, the foreign body was expelled with force, and, as if by magic, the breathing became quiet, and the venous hemorrhage ceased spontaneously. In a patient on whom I operated some few years since for the removal of a grain of corn, and in another for the removal of a watermelon seed, the same course was pursued successfully. The hemorrhage was quite free in each case, and drawn by the inspiration into the trachea, but turning the patient's face downward, the freer respiration sufficed to prevent its further flow into the trachea.

Remarks.—In this mode of operating, the great object seems to be to open the trachea promptly; but, unless in cases of threatening suffocation, as from the introduction of a piece of meat into the windpipe, there is no occasion for such haste. In removing other foreign bodies, it sometimes happens that the opening of the trachea produces such violent coughing as ejects the article solely from the efforts of the patient; but in others its escape is by no means so easy or certain as in the case just detailed. Not unfrequently it becomes necessary to remove it by means of narrow forceps, Plate XXXI. Fig. 5, though sometimes, and in my opinion most frequently, it remains for days and weeks, being subsequently thrown up in a spasmodic attack of coughing. In some of these cases, the performance of tracheotomy has been beneficial; but in others the patient has not derived such relief as would justify the operation. Caution in diagnosis and prognosis is, therefore, a matter of much importance with patients who are thus situated, and the operation should not be performed until the evidence of the presence of the foreign body and its injurious effects are quite apparent.

III. **Tracheotomy for Epilepsy.**—The suggestion of Marshall Hall, to relieve one of the forms of Epilepsy (Laryngismus) by opening the trachea, seemed at one time likely to lead to the frequent performance of the operation of tracheotomy. Notwithstanding the able arguments adduced in support of this theory by its accomplished author, the profession have not generally coincided in its propriety, and many have even regarded it as unjustifiable. In several of the patients on whom the operation has been performed, the disease was only checked temporarily, as had often been previously noticed after accidents or other events calculated to make an impression on the nervous system of the epileptic. Some of those operated on, in accordance with the suggestion of Hall, have either had a return of the disease or died, notwithstanding the existence of an opening in the trachea, through which air was freely transmitted to the lungs; and in a paper read by Radcliffe, of London, before the London Medical Society, the opinion is expressed "that the convulsions have been almost uniformly as bad as ever" after the operation. Many members of the Society doubted, therefore, whether tracheotomy was beneficial in this complaint.* In a case operated on in Philadelphia, by John Neill, the patient died with the tube in the trachea.

IV. **Laryngotomy.**—Laryngotomy may be demanded by very much the same circumstances as those which indicate the propriety of performing Tracheotomy, but the former operation is less frequently employed than the latter, in consequence of the greater risk of hemorrhage in its performance, as well as the subsequent effects upon the voice. It may be performed thus:—

Operation of Desault.—After dividing the skin and fascia superficialis by an incision which extended from the projecting angle of the thyroid cartilage to a little below the cricoid, but not near so long as that required in tracheotomy, Desault separated the thyroid muscles, placed his forefinger on the crico-thyroid ligament, and, feeling for the artery of the same name, endeavored to depress or raise it out of the line of the incision; and then, plunging the scalpel into the ligament, cut it either upward or downward, according to the position of the vessel.

When the incision is continued down through the cricoid cartilage and first rings of the trachea, it constitutes the operation which has been designated as laryngo-tracheotomy. In bad cases of Polpi in the Larynx, it may also be necessary to prolong the incision upward to the os hyoides, as was done by Buck, of New York, in the operation which is hereafter quoted.

V. **Laryngotomy for the Removal of Polypi in the Larynx.**—In two cases reported† by Gurdon Buck, Jr., of New York, the operation of Laryngotomy, as recommended by Ehrman, of Strasburg, was performed, and with considerable relief.

Operation of Gurdon Buck, Jr., of New York.—The patient being seated before a window, on a low arm-chair, with the head thrown back and the front legs of the chair raised about three inches, on blocks, an incision was made for about four inches in the median line of the neck, dividing the skin and subjacent tissues till the laryngeal cartilages and the three upper tracheal rings were laid bare, the latter being done partly by lacerating and partly by depressing the isthmus of the thyroid gland. The hemorrhage having ceased, the crico-thyroid membrane was incised, and the incision continued upward in the median line, with the greatest precision, throughout the whole extent of the thyroid cartilages, the division being made with the scissors in consequence of the ossification of the cartilages. The section being then continued through the cricoid cartilages and the exposed rings of the trachea, the sides of the larynx were stretched apart, with retractors, thus exposing the polypus growth attached to its lateral walls. On snipping off the polypus the hemorrhage

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* London Lancet, 1853.

† Transact. Amer. Med. Association, vol. vi. p. 509, 1853.

(which was of short duration) was absorbed by pieces of sponge held in the forceps, and the blood thus prevented from flowing into the trachea. A portion of the two upper rings of the trachea being now removed on either side, the tracheal tube was introduced, fastened by a tape passed round the neck, Plate XXXI. Fig. 6, and the respiration thus rendered easy and comfortable. The wound subsequently healed kindly around the tube, which was changed once in twenty-four hours, and the patient soon found that by closing the outer orifice of the tube she could breathe through the nostrils, and also blow her nose. The disease having reappeared after three or four months, a second operation was performed, the incision being carried along the median line, from the upper margin of the opening occupied by the tube, to within one inch and a half of the chin, so as to expose the whole of the larynx and os hyoides. It was also extended downward one inch below the opening for the tube, when it was removed and the larynx split open to its whole extent. After overcoming many difficulties in removing as much as was possible of the tumor, the wound was closed by three sutures above the tube, when the latter was replaced. The subsequent changing of the tube often caused considerable hemorrhage; and, the tumor again becoming developed, a third operation, of a similar character, was performed. This wound also healed kindly, but the difficulty in removing the tube was again experienced and the disease again progressed, though the patient did not die until nearly fifteen months after the first operation, without which, Buck supposes, she could have lived but a short time. In employing the tracheal tube, Buck advises that it should be made with a large opening on the convex side of its curve, in order to permit the use of the voice and the expulsion of matter from the trachea when the outer orifice is closed.

Estimate of these Different Operations.—Tracheotomy presents so few dangers that are not equaled by the operation of laryngotomy, and has, in several diseases, so many additional points of recommendation, that the latter is but seldom resorted to. In selecting a mode of operating, preference may, it is thought, be justly given to that described at the commencement of this section. The advantages which I think it possesses are: first, less risk of hemorrhage in consequence of the surgeon lacerating the parts about the median line of the muscles, instead of dissecting them, as well as from his ligating the isthmus of the thyroid gland previous to incising it; second, the preservation of the opening in the trachea without irritating its lining membrane, by the application of the blunt hooks to the sides of the wound, the tracheal wound remaining patulous, if not closed by the adjacent tissues, or resorting to an instrument, like a canula, that exposes the patient to the risk of suffocation by its escape from the wound, or clogging with the secretions of the part; and, third, the power of looking into the windpipe, and judging accurately of its condition, or of applying remedies to correct it, if desirable. Indeed, much of the success which has attended this operation in the hands of Trousseau and others seems to have been due to their judicious after-treatment, especially keeping the wound covered by gauze, and moist so as to obviate the dryness of the trachea caused by evaporation in breathing through the wound.

The excision of even a small portion of the rings of the trachea, in order to aid in preserving the opening, has been objected to by some surgeons as being likely to cause a subsequent contraction of the canal when the wound cicatrizes. But in the patients who have recovered, this has not been the result. In Bigelow's case,* after employing a tube two days, it was deemed better to remove it, and excise a portion of the tracheal rings, and subsequently a dilator of wire was kept at the orifice of the wound.

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* Am. Journ. of Med. Sciences, vol. xxvi. N. S. p. 81.

The points especially worthy of notice in the performance of tracheotomy may then be summed up as follows: 1st, to lacerate and stretch, rather than dissect the parts about the trachea; 2d, to check all hemorrhage by the ligature before opening the canal; 3d, to clear away the condensed connective tissue (tracheal fascia) around the proposed opening; 4th, to keep the wound covered with fine and constantly moist gauze; and, lastly, to keep the wound and orifice in the trachea distended by a spring or by hooks, Plate XXX. Fig. 12.

To those not familiar with the details of this operation, it may also be useful to state that the puncture of the trachea generally brings on a most violent and convulsive cough, during which little or nothing can be done. This, however, usually passes off as soon as the first stimulus of the cold air ceases to be felt. When, then, an incision is to be made into the trachea, it should promptly follow the puncture of the knife, or if a tenaculum is inserted, in order to favor the removal of a portion of the rings, their excision should be quickly effected after the hook is introduced, the violence of the cough consequent on the puncture being sometimes so marked as to alarm the by-standers for the life of the patient.

It is now doubtless apparent, from reading the above estimate of tracheotomy, that I regard it as an operation requiring some skill and preparation on the part of the surgeon, and that it should not be attempted by any practitioner, unless totally regardless of consequences. No matter how simple the operation may appear upon the dead subject, or upon the healthy adult, it will often prove to be a difficult one when the vessels are rendered turgid by dyspnœa, or when it is to be performed on the short, fat neck of a child, or when it is resorted to on a patient apparently at the last gasp, whose larynx and trachea are actively raised and depressed at every respiration. To the experienced surgeon such facts are well known, but to those who have judged of the operation solely from its performance in the dissecting-room, such statements should create caution and lead them to anticipate difficulties, if they are induced to operate. In all cases, special precautions should be taken in regard to hemorrhage, as, in some instances, the flow of blood has been of the most alarming and intractable kind. Desault,* whose skill no one can doubt, was, it is said, compelled to give up an operation, on one occasion, in consequence of hemorrhage; and Recamier has advised surgeons to defer opening the trachea for several hours, lest the patient should suffer from a flow of blood. Roux, also, is reported to have saved one of his patients from the suffocation caused by the blood escaping into a trachea which had been promptly opened in hopes of arresting it, only by placing his own mouth to the wound and sucking it out. In a recent number of the *Gazette des Hôpitaux*, as translated by Fraser, and published in the *Transylvania Medical Journal* for June, 1853, is also an account of a discussion on Tracheotomy in the French Academy of Medicine, in which the serious character of the operation is admitted both by Guersant and Boyer. When, therefore, tracheotomy is spoken of "as an operation not much more difficult than venesection," the opinion should be received with some hesitation, as it may be the result of the want of experience on the part of those who utter it.

Supposing, however, that the operator is aware of these dangers—and it is admitted that they are not universally encountered—the question which has of late years occupied so much of the attention of surgeons yet remains to be decided, to wit, Should tracheotomy be resorted to for the relief of all patients who are liable to die asphyxiated? That such a recommendation cannot be universally admitted requires no argument, and the proposition may, therefore, be more definitely settled by showing in what cases the performance of this operation may be advisable.

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* Dict. de Méd., tome vi. p. 58.

That an opening may be made into a healthy trachea for the removal of a foreign body, or in order to overcome a spasm of the glottis caused by inhaling a noxious vapor, or in cases of edema of the glottis, is a point which I cannot but regard as settled by statistics. From an examination of various cases as reported, as well as from a review of many of the works upon Surgery, from a very early period, I am inclined to think that tracheotomy, in such cases, is not only a justifiable operation, but also one which furnishes the patient with a ready means of escape from the dangers likely to ensue. And although instances are recorded in which nails and coins have remained in the windpipe for years, and even in the lungs, without destroying life, there are others, well authenticated, where the presence of a small bean, or of a grain of coffee or of corn, has induced laryngeal phthisis, ulceration, and death. In edema of the glottis, though the operation of tracheotomy may be required, I would not resort to it until scarification of the parts had been fairly tried; but this being done, I should anticipate from tracheotomy prompt and permanent relief. In hydrophobia, I should certainly be disposed to try it rather than see the patient die without the operation.

As to the propriety of advising tracheotomy in cases of membranous croup, there is apparently so much of the result that might be charged to the peculiarity of the mode of operating heretofore employed, and to the delay that has generally preceded its performance, that the decision of the question must be considered as "sub judice." By referring to the statistics hereafter quoted, an opinion of the success of the operation, as usually performed, may be readily obtained, and it is one which has gone far toward diminishing professional confidence in this operation as a means of treating croup. Very many of the best surgeons at different periods have, in their day, doubted its propriety or only advocated its performance at the last moment. In the United States, the experience of Physick was adverse to it; and in Boston, the opinion of some of the profession is at present opposed to its performance, as I noticed no reply was given* to the question proposed by Storer, of Boston, to the members of the Society for Medical Improvement, whether "Tracheotomy had ever been successfully performed in that city in membranous croup?" More extended statistics, as collected for this volume, also show that the prognosis of the operation, as heretofore performed, should be very guarded.

In most of the cases as yet reported, tracheotomy has, however, been deferred until the complaint had existed some time, and the inflammation progressed from the larynx into the trachea, or induced congestion of the lungs, or augmented the dangers from the incisions, by causing engorgement of the vessels of the neck; while in others there was an unhealthy condition of the lining membrane of the trachea at the point operated on, or sometimes sloughing of the wound, and constant irritation from the changing of the tube employed to preserve the opening in the trachea. Until, then, we can acquire such statistics as will show that in the cases operated on at an early period after a positive diagnosis of membranous croup has been made, and operated on so as to leave an opening which by the use of glycerin would not be liable to clog with mucus, while it is also kept free from the continued irritation of a tube, by the use of the hooks or spring—Plate XXX. Fig. 12—the number of deaths correspond with the mortality under the former mode of operating, this question cannot be regarded as settled. Cauterization of the pharynx and trachea through the mouth, together with early depletion, calomel and emetics, have saved many cases of true membranous croup, and will, consequently, be strong arguments against the performance of an early operation. But when croup occurs in those who are hereditarily predisposed to it, or when other members of a family have died from it, I would advise an *early* operation, and anticipate more success from it than I should from medical means alone, provided the operation was resorted to before the inflammation had reached the portion of the trachea which was to be opened, and the wound was kept dilated by hooks introduced upon its sides. The chief difficulty here is to designate any signs which would indicate that inflammation of the tracheal membrane had not gone too far, since auscultation furnishes no evidence that can be relied on, De La Berge and Moneret* citing one case, in which, though the vesicular murmur was extremely pure and heard everywhere, yet during the operation a false membrane was drawn out which represented the trachea and division of the bronchia; and Pepper, of Philadelphia, having also reported† one similar case, and another in which, though the respiratory murmur could not be heard, yet the exudation was strictly confined to the larynx. The only test that I know of is the one suggested‡ by my friend, J. Forsyth Meigs, of Philadelphia, in which he states that in some patients the pulse was much less rapid when the disease was limited to the larynx and trachea than it was when it had invaded the bronchia. In two cases involving the bronchia, the pulse counted 140 to 150 for several days prior to death, while in two others in which only the larynx and trachea were diseased, as shown *post mortem*, it counted only 120 or 130. In the case reported by Pepper, in which the disease was found after death to be confined to the larynx, the pulse was also only 120 the day preceding its termination. Meigs also suggests that the signs of asphyxia will have existed longer and come on more slowly and gradually when the bronchia are diseased than they will in those in which these tubes are not involved. He therefore advocates the operation in hopes of saving some who would otherwise certainly perish. Although I am not so sanguine in regard to the *frequent* success that might ensue if the operation of tracheotomy, in croup, was performed at an early period, I think that it is justifiable in many cases, and especially in those with a pulse not above 120, especially if the parents are anxious for the operation, the moral comfort often afforded them by the thought that everything possible had been done to save the life of an object of deep affection being sufficient to justify the performance even where death ensued. Like the operation for strangulated hernia, tracheotomy, to be moderately successful, must be performed before the changes in the part caused by disease are likely to render it useless.

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* Amer. Journ. Med. Sciences, vol. xxvi. N. S. p. 81, 1853.

Statistics of the Operation of Tracheotomy.—In order to show the data upon which the opinion just expressed has been based, I have collected from various sources the reports of the operation, as performed for the relief of croup as well as for other purposes, and present them in the tabular form, as being that which most readily exhibits the result.

Tracheotomy for Croup.—The following table shows the success obtained from the operation of Tracheotomy, as usually performed for the relief of membranous croup, the wound being mostly kept open by means of

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[*] Practical Treatise on Diseases of Children, by J. F. Meigs, M.D., 2d edit. p 111. Philad. 1853.

[†] Summary Trans. College of Physicians of Phila., vol. iii. p. 106.

[‡] Am. Journ. Med. Sciences, vol. xvii. N. S. p. 332, 1849.

a canula in the windpipe. This table contains all such cases as were accessible to me, and may be relied on, in the formation of an opinion, as far as any mere enumeration of the result of any operation can be, unless more details of the cases were furnished than is compatible with the limits of this volume. As the Bibliographical Index at the end of this part presents a full reference to such of the cases in the following table as were reported by American surgeons, those desirous of further details will find them in the journals there quoted.

OPERATOR.	OPERATIONS.	CURED.	DIED.
Amussat	6	0	6
Baudelocque	15	0	15
Blandin	5	0	5
Bretonneau	18	4	14
Gerdy	6	4	2
Guersent	9	0	9
Guersent, Hôpital des Enfans Malades, in 1850	20	6	14
" " " " 1851	31	12	18
" " " " 1852	59	11	48
This success was owing to greater attention to the treatment of the wound.			
Maslieurat	2	1	1
Petit	6	3	3
Roux	4	0	4
Velpeau	6	0	6
Trousseau	153	41	112
Pancoast	9	4	5
Page	1	0	1
Smith	1	0	1
Thompson	1	0	1
E. Atlee	1	0	1
Townsend	1	0	1
Van Buren	1	0	1
Buck, Jr	2	2	0
Johnson	1	0	1
Goddard	1	0	1
Burgess	2	1	1
McIlvain	1	0	1
Carter Johnson	1	0	1
Pitney	1	1	0
Ayres	1	1	0
Bigelow	1	0	1
	366	91	274

From this it is seen that of 366 cases of tracheotomy performed for the relief of croup, in which the operation was not resorted to until nearly every other means had been tried, only 91 were cured, while 274 died, that is, in the 366 cases operated on, only two more than one-fourth of the patients recovered.

Since the publication of the preceding statement in the second edition of my "Operative Surgery," the statistics of tracheotomy in croup have accumulated, but without augmenting the ratio of cures. Trousseau's recent experience has only confirmed his former opinion as to the propriety of the operation, regarding it now "as a *duty* as imperative as that of ligating the carotid artery after a wound of that vessel."

In the *Gazette des Hôpitaux*, as republished in the *Southern Medical and Surgical Journal* of November, 1858, there is published the statistics of the *Hôpital des Enfans Malades* of Paris, in tracheotomy, as performed during the last ten years. The years 1850–51–52 having been included in the preceding table, I only add the account of the subsequent years.

	OPERATIONS.	CURED.	DIED.
1853	61	7	54
1854	45	11	34
1855	48	10	38
1856	55	14	41
1857	71	15	56
	280	57	223

From which it appears that since the year 1853 the mortality is as 1 in 4 to 1 in 5 of the whole number operated on yearly—though it must be remembered that the majority of the cases operated on were in the last stage of croup, and therefore in imminent danger of death.

Guersent admits the mortality to be greater in proportion to the age of the child, those under two years presenting peculiar difficulties in the performance of the operation, and in several instances dying in convulsions during its performance. One decided contraindication to the operation is admitted even by Guersent, and that is general diphtheritis, false membrane being seen in the throat, etc., as well as on the vocal chords.

George H. Gay, of Boston, has however reported* two cases of recovery after the operation, where false membrane was coughed up, and also seen in the fauces of one case. Of six cases operated on by Gay, four recovered, a success which he ascribes to the comparatively early period of his operations.

The house surgeons of the Hospital for Infants reply in substance as follows to the three questions:—

1. On what symptom, at the different periods of croup, do the house surgeons of the Hospital for Infants resolve upon performing tracheotomy?
2. What symptoms induce them to abstain?
3. What symptoms lead them to temporize?

First. They *operate* when, in spite of medical treatment, the difficulty of breathing rapidly increases, the general symptoms are aggravated, and the paroxysms of suffocation occur frequently and at short intervals. The Asphyxia is accompanied with Cyanosis in some cases, with paleness in others; in both the operation is proper.

Second. They are deterred from operating on children under two years of age, and operate reluctantly on those under two years and a half. They do not operate when manifest general infection of the system exists, as indicated by the simultaneous existence of livid paleness, swelling of the submaxillary, cervical, and sometimes Parotid glands, with general tumefaction of the neck, and edema unconnected with the glandular swelling,† the breath being fetid, and the pulse small and feeble. Also they do not operate in general Diphtheritis, as indicated by the symptoms just mentioned with serous coryza, and secretion of false membranes behind the ears, at the vulva, or on blistered surfaces.

Third. They hesitate in the presence of thoracic complications. In Pneumonia, they operate if the inflammation is limited to one lung and the condition of the patient is otherwise favorable, but they do not operate in cases complicated with double Pneumonia.

In cases of Pseudo-membranous bronchitis, indicated by the ejection of cylindrical and evidently bronchial false membranes, they are guided by the general state and age of the patient.

The next table shows a very different result, the operation of tracheotomy being performed at a period when the trachea was not diseased.

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* Boston Med. and Surg. Journal, 1858.

† The Virginia Medical Journal, Nov. and Dec. 1859, from Champonniere's Journal.

Tracheotomy for the Removal of Foreign Bodies, etc.—This table contains cases collected by myself, and reported up to January, 1860.

	CURED.	DIED.	SUBSTANCE.
John Newman, N. C.	1		Bullet.
Amassa Trowbridge, N. Y.	1		Bean.
H. G. Jameston, Md	1		Watermelon seed.
" " "	1		Pebble.
Samuel Cartwright, Miss.	1		Watermelon seed.
H. T. Waterhouse, N. Y	1		Watermelon seed.
Joseph Palmer	1		Bean.
Richard Burgess		1	
Peter P. Woodbury, N. H	1		Bean.
Calvin Jewett, Vt	1		Bean.
" " "	1		Iron nail near two inches long.
Enos Barnes, N. Y	1		
Abner Hopton, N. C	1		Grain of corn.
Zadok Howe, Mass	1		Bean.
J. F. Hardy, N. C.	1		Watermelon seed.
Charles Hall, Vt	1		Pipe stem.
J. Mason Warren, Mass	1	3	Bean, pin, carpet-tack, nail.
Twitchell, N. H	2		Bean.
William Davidson, Ind	1		Grain of corn.
W. H. Van Buren, N. Y.	1		Plum stem and watermelon seed.
J. H. Kearny Rodgers, N. Y	1		Cherry stone.
Evans, Ky	1		Vapor of hot water.
N. R. Smith	1		(Laryngotomy.) Cockle bur.
Liston	1		Glass seal.
Pancoast	3	1	Result not stated.
Henry H. Smith	3		Grain of corn 1, cured; watermelon seed 1, cured; grain of coffee 1, cured.
Brainard	1		Abscess at root of tongue.
Gilbert	3		Coffee grain, raw potato, corn.
Moorehouse	1		Almond shell.
May	2		Coffee and corn grains.
Neill	1		Epilepsy.
Hoyt	4		Bean.
Trabue	1		Corn grain.
W. H. Mussey	1		Soup bone (chip.)
	Cured 44	Died 5	Total 49.

From this it appears that, in 49 cases of tracheotomy performed for the removal of foreign substances from the trachea, 44 were cured, and only 5 died—the trachea being allowed to close and heal as soon as possible after the operation.

In comparing the results of these two tables, it is very evident that the dangers which ensue upon incising a healthy trachea are comparatively slight, and that the great mortality which has attended the operation, when performed for the relief of croup, must be due to some other cause than the mere incision of the windpipe. But whether this cause is to be found in the changes produced by the disease, or whether it is the result of an incision in an inflamed instead of a healthy structure, or whether it is not owing to the delay usually attending the performance of the operation, is a point which can only be settled by each operator hereafter specifying the peculiarities of his cases.

CHAPTER IV.

DISORDERS OF THE THROAT AND NECK.

SECTION I.

ANATOMY OF THE THROAT.

THE term **Pharynx** is applied to all the upper portion of the œsophagus, or the orifice of the gullet, and is formed by a series of muscles which are designated as the superior, middle, and inferior constrictors; the object of these being to seize upon the bolus of food, and, by their successive contraction, carry it down into the œsophagus, the muscular coat of which, by like contractions, carries it down into the stomach. The pharynx is attached posteriorly to the bodies of the vertebræ by a certain amount of loose connective tissue, which, like all connective tissue, may become the seat of inflammation and abscess. The entrance from the mouth into the pharynx is guarded on each side by the two half arches of the soft palate, which have between them the tonsil gland. Just below this point, and anterior to the pharynx, or at the root of the tongue, is the epiglottis cartilage, which closes the orifice through which the air passes into the larynx and trachea when the patient swallows. As the thyroid cartilages, which compose the upper part of the larynx, are open posteriorly, or rather united only by fibrous tissue, they do not afford that protection to the surface of the larynx which is next to the pharynx that they do on its front, while the rings of the trachea being also imperfect on the posterior side, any force that distends the pharynx and œsophagus acts with great readiness upon the air-passages, so as to produce compression and all the consequent symptoms of difficulty of respiration, and strangulation. It should also be noticed that the situation of the great vessels of the neck, in regard to the œsophagus and pharynx, is such that any forcible distention of the œsophagus or pharynx is liable to interfere with the freedom of the circulation, by inducing spasm of the muscles of the neck, and thus compressing the veins which bring the blood from the brain.

SECTION II.

DISORDERS OF THE THROAT.

§ 1.—Foreign Bodies in the Pharynx.

The foreign bodies which are most likely to get into the pharynx are such as are ordinarily taken into the mouth for the purposes of nutrition, although bodies of various characters may, through a variety of accidents, obtain the *same position*. Of the first variety of foreign bodies, the most common are such as fish-bones, especially the smaller bones of such varieties as the herring or shad, the smallness of which causes them to pass unnoticed to the fauces, when, getting transversely, their length is sufficiently great to cause them to lodge across the pharynx; or the offending substance may be a piece of tough meat or gristle taken into the mouth during a meal. Of the second kind are foreign bodies taken into the mouth for any purpose and accidentally swallowed, such as pins, which are often held in the mouth by housemaids and others, bits of glass, beads, coins, etc.

Seat.—When any of these substances are swallowed, the first place at which their progress is likely to be arrested is at the half arches, where the body, if sharp, such as a pin, needle, or fish-bone, will often be found sticking directly into the structure of the tonsil, it being sometimes imbedded by means of the spasmodic contractions of the isthmus of the fauces, the muscular contractions of which have occasionally such power that cases are on record in which pins and similar pointed articles have been driven completely through the fauces, so as to wound the great vessels of the neck.

Diagnosis.—In these cases, the surgeon will generally be able to recognize the foreign body by the sight, simply by directing the patient to open his mouth widely; but if, from the minuteness of the substance or its position, he fails to do so, and the symptoms clearly indicate its presence, he should have no hesitation in introducing his finger into the throat, by means of which the substance, if present, can always be felt.

Very frequently, however, it passes the isthmus of the fauces, and becomes fast in the pharynx, where it may generally be looked for about the bottom of the middle constrictor muscle, though sometimes it is held in the embrace of the superior constrictor. Here, also, its presence can be recognized by means of the finger, which, under these circumstances, should be passed down a little below the orifice of the larynx.

Symptoms.—When a foreign body is arrested in the pharynx, it is very apt to produce such pressure upon the larynx or trachea as will be followed by violent spasm in the muscles of respiration, with evidence of strangulation. As a general rule, foreign bodies which pass fairly into the pharynx, yet are of such a size or shape as prevents their passage into the stomach, hitch upon a point that corresponds with the posterior face of the larynx, and, irritating the thyroid muscles, induce spasms which are very violent in their character, owing to the irritation of the nerves of respiration. The patient therefore soon gasps and struggles for breath; while, by the contraction of the respiratory muscles thus thrown into a state of spasm, the larynx is pressed forcibly back upon the foreign body, and the danger is increased.

Treatment.—The treatment in these cases must always be prompt, particularly if the foreign body is large, as the spasm will soon result in closure of the glottis, when the patient will be suffocated in a few minutes.

A person when seen making these violent spasmodic efforts, under circumstances which would lead to the suspicion of a foreign body being the cause, should, therefore, at once be compelled to lean forward and drop his head upon the chest in such a manner as to relax the muscles of his throat, and thus prevent as much as possible the occurrence of contraction in such muscles as will, by forcing the larynx against the pharynx, only increase the evil. Then, having widely separated the jaws by means of a fork-handle or a cork, thrust a finger into the throat and hook out the foreign body if possible, when the relief will be prompt.

If, however, this manipulation should fail, the patient's head should be retained by assistants in the same position, while the surgeon resorts to more efficient means hereafter mentioned.

SECTION III.

DISORDERS OF THE NECK.

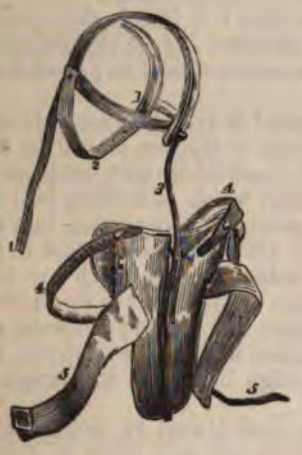
§ 1.—Disorders of the Muscles of the Neck.

Torticollis, or **Wry-Neck**, is an affection connected with the muscular structure of the neck, which is generally due to a spasmodic contraction, often a permanent one, of the sterno-cleido-mastoid muscle.

Treatment.—In its milder form this disorder is only a rheumatic affection of the muscle, and may be readily relieved by means of warm stimulating frictions, a very good article for the purpose being found in the tinctura saponis camphorata, combined with a due proportion of the tincture of the root of aconite; or it may be necessary to abstract blood by cups. The popular plan of covering the neck with a damp cloth, and ironing it with a warm flat-iron so long as the patient can bear it, is also not a bad stimulating mode of treatment.

A more permanent contraction of the muscle requires, however, a more decided course of action; and it should be borne in mind that here, as in strabismus, while there is a preternatural contraction of the muscle of one side, there is a marked relaxation in its antagonistic muscle, so that if the condition has existed for some weeks or months, and promises to remain, it may be necessary to resort to an operation, this being conducted upon precisely similar principles to that alluded to in connection with strabismus; but here the operation must be followed by the proper application of mechanical means to overcome the contraction. The operation of *myotomy*, as generally practiced for the relief of these deformities, is a very simple one, and only dangerous in the hands of a surgeon grossly ignorant of the anatomy of the part. The mode of performing it will be described hereafter.

Fig. 425.



HELMET, ETC. FOR THE TREATMENT OF TORTICOLLIS AFTER THE OPERATION OF MYOTOMY.—1, 2. Straps to pass under the chin and around the head. 3. A movable rod to adjust the helmet to necks of different lengths. 4, 4. Straps to surround the shoulders. 5, 5. Straps to fasten the shoulder-brace around the chest, and thus furnish a point of support for the apparatus. (After Nature.)

As the new tissue formed by the organization of the lymph which is thrown out between the edges of the divided muscle is very extensible, it should subsequently be brought to such a length as will insure a removal of the deformity by means of various mechanical contrivances, such as are to be found either in the handkerchief of Mayor, specially designed for this purpose, or in an instrument which regulates the position of the head by means of a pad and screw, or in a sort of helmet, with shoulder-bands so contrived as to hold the head in the proper position, Fig. 425.

§ 2.—Hydrocele of the Neck.

Hydrocele of the Neck is the name given to a disease which consists essentially in the accumulation of fluid in the proper structure or in the capsule of the thyroid gland. This fluid is generally serous in its character, the conditions favoring its development, and the pathological changes which are its proximate cause being very imperfectly understood. Its treatment is that of hydrocele of the tunica vaginalis testis. Thus, its contents should be evacuated by means of a trocar and canula, and the tendency to its reproduction overcome by means of injections of some stimulating substance, that most frequently used being a solution of the tincture of iodine in water, gradually increased in strength until sufficient adhesive inflammation is established to obliterate the cavity of the sac.

A fistulous orifice is sometimes left which requires stimulation by caustic, or the removal of the sac by dissection, before it can be healed.

CHAPTER V.

OPERATIONS UPON THE PHARYNX AND ŒSOPHAGUS.

THE **Oesophagus** is liable to various affections, the relief of which often demands more or less interference on the part of the surgeon. Among the more important of these complaints may be mentioned those resulting from the passage of foreign substances, of a hard and irritating nature, which being inadvertently introduced into the mouth, are thence carried down the œsophagus toward the stomach, and liable to be arrested at various points; as well as the disorders consequent on inflammation in or around the proper structure of the canal itself. From the importance of this tube, and the difficulties of reaching it from the outside of the neck, its relations to surrounding parts should be thoroughly studied by the surgeon before attempting any of the cutting operations sometimes required for its relief.

SECTION I.

SURGICAL ANATOMY OF THE PHARYNX AND ŒSOPHAGUS.

Although to an ordinary observer the **Oesophagus** is one continuous canal, which reaches from the mouth to the stomach, anatomists have usually divided it into the **Pharynx**, or that funnel-shaped cavity which extends from the base of the cranium to the lower part of the cricoid cartilage, between the cervical vertebræ and the posterior part of the nose and mouth, and into the **œsophagus** proper, or the tube which extends from the same cartilage, or lower part of the fifth cervical vertebra, to the cardiac orifice of the stomach.

rived from the pharyngeal muscles. On dividing this stratum with the knife, and pressing it aside, this portion of the tumor was also removed with the forceps and fingers, though not without great difficulty, as it was found to be attached to the ramus of the lower jaw, near the sigmoid notch, to the pterygoid process of the sphenoid bone, and to the posterior aperture of the right nostril. The hemorrhage was smaller than might have been anticipated, but required to be checked occasionally by cold water, thrown into the pharynx with a syringe, after which the cheek was united by sutures and adhesive straps, the ligature around the carotid artery being allowed to remain until next morning as a precautionary measure. This patient soon recovered, and the microscope showed that the tumors were purely fibrous, and without any evidence of a cancerous degeneration.

§ 3.—Retro-Pharyngeal Abscess.

The formation of an abscess in the connective tissue situated between the posterior wall of the pharynx and the fronts of the bodies of the cervical vertebræ is an affection which, from its frequent fatal result, by extension of inflammatory action to the glottis, and its effects upon the trachea, should be promptly treated. Although long noticed by surgical writers, the dangers of this affection and the necessity of prompt treatment have not been generally insisted on. In a paper published* by Allin, of New York, the fatal character of the complaint is justly noted, as well as the liability of the surgeon to overlook its existence. Of the fifty-eight cases referred to by Allin, only twenty-eight were relieved or cured, or about one-half died. Owing to the distance of the abscess from the mouth, and the liability of the matter to escape suddenly into the larynx, various means have been advised for its evacuation, as the trocar and canula, etc. A simple and safe method will be found in the plan pursued by Allin.

Operation.—The patient's head being firmly supported by an assistant, pass the forefinger of the left hand into the mouth, depress the tongue, raise the velum palati, and press the point of the finger against the tumor. Then pass a sharp-pointed bistoury, the blade of which is covered with adhesive plaster, to within half an inch of its point, along the left forefinger as a director, and make a free incision through the walls of the pharynx, on the median line of the throat, so as to open the cavity of the abscess. By this free incision, fistulous tracks will be avoided, and simple detergent washes will complete the cure.

SECTION III.

OPERATIONS UPON THE ŒSOPHAGUS.

The Œsophagus, being the principal channel by which substances enter the system, is liable to various complaints in consequence of the improper character of the articles introduced into the mouth. Particles of food taken at a high temperature, or imperfectly masticated; or foreign bodies intended to be held temporarily in the mouth, but which are suddenly swallowed; or a diminution of the calibre of the passage, owing to various causes, are all instances of the evils to which a patient may be exposed in the daily use of this part. Two specifications will, however, embrace all the operations required by this structure, independent of wounds, to which it is liable in connection with other parts of the neck, to wit—the removal of foreign substances from it, or from the stomach, and the restoration of its natural calibre, in cases of stricture.

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* New York Journ. Med., vol. vii. p. 325.

§ 1.—Removal of Foreign Substances from the Oesophagus.

Various means have been suggested for the removal of foreign substances from this canal, such as forceps, hooks, and sponges. Without entering into the details of these inventions, it may be sufficient merely to direct attention to such as will be found in Plate XXX., among which can be seen the forceps of Bond, and a hook brought to the notice of the profession in the United States, by Nathan Smith, of New Haven.* An instrument, very similar to this, is also represented as copied from the European plates, the invention of which is assigned to Dupuytren; but as no date is given to it, I have found it difficult to establish the priority of either, the difference in the character of the two being very slight. Dupuytren has claimed the hook as his; but whether he followed Smith, or preceded him, the latter states explicitly that "his hook is unlike anything which he has known to be employed for a similar purpose;" and he therefore furnishes a drawing of it in the paper referred to,† deeming it especially suited to the removal of coins. Both hooks, though adapted to a certain class of foreign bodies, are not applicable to all; and, as compared with the gullet forceps of Bond, are thought to be inferior. The latter is capable of taking hold firmly and extracting safely any foreign substance, no matter how fine or small, which is within the grasp of the instrument, that is, two or three inches below the top of the sternum, measuring from the mouth, and yet not liable to pinch the internal coat of the canal, while the hooks are only adapted to larger objects.

Operation with Bond's Forceps.—Place the patient in a strong light, with the head thrown back, if the foreign substance is small, but, if large, with the chin approximated to the sternum, so as to relax the sterno-hyoid and thyroid muscles, lest, by compressing the trachea against the bodies of the vertebræ, the foreign article be caused to impinge on the larynx, and such a spell of coughing be induced as will materially interfere with the operation. Then, placing a plug between the molar teeth, depress the tongue with the forefinger of the left hand, and pass the forceps into the œsophagus with the right hand, when the substance, if high enough to be seen, may be readily extracted; but if lower down, the tongue should be depressed by an assistant by means of the instrument, Plate XXX. Fig. 11, while the surgeon, opening and shutting the blades of the forceps, should carry the handles from left to right, or the reverse, so as to sweep the œsophagus with the points of the instrument. Should it be a coin, or a similar article, the dilatation of the walls of the œsophagus will render the passage of the blades on each side easy; but if it is a smaller body, as a pin or fish-bone, the operator need not fear an injury to the walls of the canal, as the instrument is so constructed as to render such an event almost impossible.

Weever, of Michigan, has also published‡ the description of a pair of forceps, consisting of a two-bladed whalebone stylet, which, being inserted in a flexible catheter, is passed down to the substance, pushed out of the catheter so as to expand on each side of the article to be removed, and then made to

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* New York Med. and Phys. Journ., vol. iv. p. 576, 1825.

† See Plate XXX. Fig. 4.

‡ Amer. Journ. Med. Sciences, vol. xiv. p. 111, 1834.

PLATE XXXII.

OPERATIONS PRACTICED ON THE ŒSOPHAGUS AND LARYNX.

Fig. 1. A front view of the application of the Œsophageal Hook of Dupuytren as represented upon the subject, by a section of the mouth. 1. A longitudinal section, showing the left half of the tongue. 2. A vertical section of the lower jaw. 3. Top of the epiglottis cartilage as applied over the glottis in the effort of swallowing. 4. The upper end of the Œsophageal Hook. 5. Its lower extremity, with the basket attached to it. 6, 6. Dotted lines showing the course of the Œsophagus. *After Bourgery and Jacob.*

Fig. 2. A front view of a section of the Mouth and Throat, showing the application of the sponge to the Larynx, as advised by Trousseau and Green. 1. Longitudinal section of the tongue. 2. Inferior maxilla. 3. Os hyoides. 4. Section of the epiglottis cartilage. 5, 5. Sections of the thyroid cartilage. 6. Point to which the sponge may be introduced. 7. Upper end of the instrument. 8. Its lower end, with the sponge in position. *After Bourgery and Jacob.*

Fig. 3. A view of the relative position of the Surgeon and Patient in the operation of washing out the stomach by means of the Stomach Pump and Œsophageal Catheter, as suggested by Physick, of Philadelphia. The patient is represented as reclining with the head thrown back, and the jaws distended by a plug of wood introduced between the molar teeth. The Œsophageal Catheter of Physick has been introduced into the stomach, and then attached to the nozzle of the pump, which is placed in a basin close alongside of the patient. The surgeon is represented in the act of drawing the liquid into the pump from the bowl. 1. Physick's Œsophageal Catheter. 2. The Stomach Pump of Goddard. *After Nature.*

Plate 32.

Fig. 1

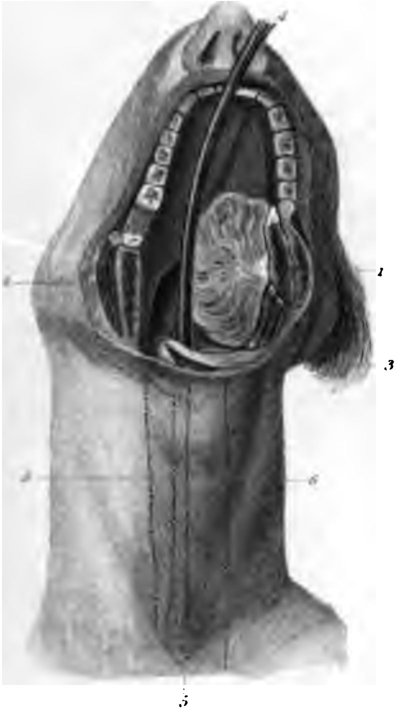


Fig. 2

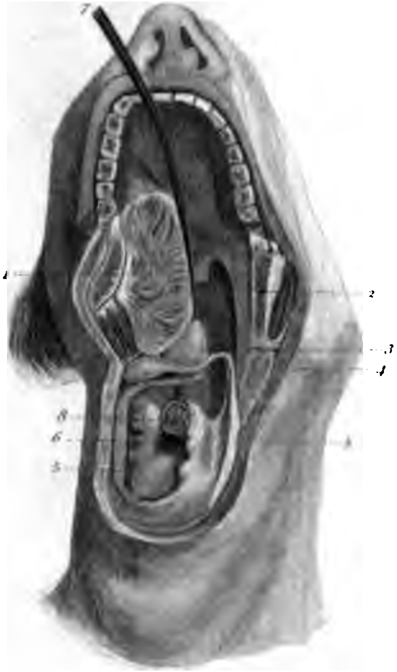
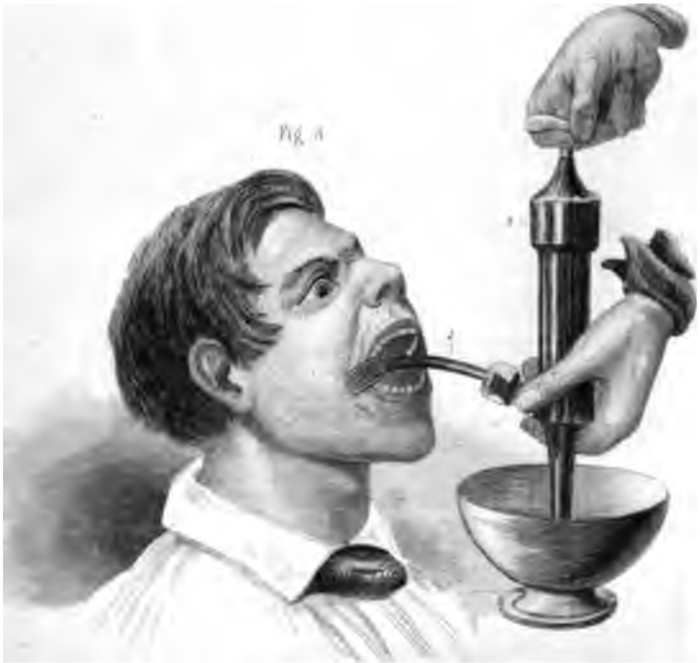


Fig. 3



seize it by pressing the catheter upon its blades. This instrument, which acts on a principle similar to that of the litholabe of Civiale, may prove useful where the foreign substance is very far down, and yet of such a nature as should forbid its being pushed into the stomach by a probang. If the article to be removed is barbed and sharp-pointed, like a fish-hook and line, no expedient will probably answer better than that suggested, under similar circumstances, by Brite, of Kentucky, to wit, the slipping of a sufficiently large and perforated bullet over the line and point of the hook, by directing the patient to swallow the bullet.

Removal by the Expansion of a Sponge carried below the Foreign Body.—David Rice has succeeded* in removing a piece of bone of the size of a twenty-five cent piece, cut into a triangle, which had lodged in the œsophagus of an old lady, about two inches below the top of the sternum, by the following ingenious plan. A piece of dry sponge, about one inch long, and large enough, when dry, to fill one-half of the œsophagus, was tied to the extremity of a whalebone sound, and passed down the œsophagus *in a dry state*, until it went below the foreign body. A little fluid being then swallowed, the dry sponge absorbed it, and, enlarging to twice its natural size, entirely filled the œsophagus; when, being withdrawn, it brought the bone with it.

When the dangers that may result from the perforation of the aorta or trachea, as the result of the continued presence of irritating articles in the œsophagus, are recollected, it may be well for the surgeon to be as unceasing as is prudent in his efforts to carry the article either upward or downward.

Where the foreign body is so placed in the œsophagus that its position can be distinguished by the touch externally, the propriety of performing œsophagotomy is a question worthy of consideration. Many substances of a durable nature have, however, been known to remain for years in the œsophagus without creating intolerable inconvenience, one of which is reported by Dorsey, of Philadelphia, and the possibility of such a condition should always, therefore, be recollected. In this case a copper coin remained thirteen years in this tube without destroying life; and on one occasion I removed an old-fashioned copper cent from the gullet of a little girl, where it had remained three weeks without its presence being positively recognized. On the other hand, very small substances, especially when presenting sharp edges, have ulcerated through into the trachea, or penetrated the vessels, or injured the important nerves about this region, though they have also occasionally created abscesses, and thus been discharged externally.

§ 2.—Poisons in the Stomach.

As the stomach is mainly evacuated through the œsophagus, we may now study the effects of poisons found in this viscus, whether introduced accidentally or with murderous or suicidal design.

Varieties.—These poisons may be divided into three great classes: 1, those from the mineral; 2, those from the vegetable; and 3, those derived from the animal kingdom.

1. The mineral poisons most frequently taken are arsenic, corrosive sublimate, salts of copper and lead, and the mineral acids, such as the sulphuric, nitric or muriatic acids, and the like.

2. The vegetable poisons are generally narcotic articles, such as opium, cicuta, stramonium, belladonna, laurel, etc., as well as mushrooms, truffles,

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* Boston Med. and Surg. Journ., Dec. 3, 1857.

and other similar articles of diet in particular constitutions and under certain circumstances; there are also some vegetable poisons which are not narcotics, yet are highly poisonous, as strychnia.

3. The poisons derived from the animal kingdom are very various, those perfectly innoxious in some seasons being sometimes poisonous under diverse conditions; thus fresh pork, so generally used as an article of diet, will act upon certain constitutions, in hot weather, as a positive poison; and this, perhaps, not merely from its nature, but also from the manner in which it is often eaten, being bolted in masses that are unmasticated. In some cases of poisoning thus induced, a brisk emetic has occasionally brought away large lumps of undigested pork several days after they were swallowed, the debility, delirium, and cutaneous eruption disappearing soon after the pork was vomited. Poisoning from this cause has been sometimes noticed among the laboring classes in the summer season. So also certain shell-fish, though often used as articles of diet, will occasionally produce in some individuals symptoms of poisoning, one being well known to me, upon whom stewed oysters will act as a positive poison, creating violent retching, evidences of gastritis, prostration, and a marked form of erythema nodosum.

Besides these ordinary articles there are certain animal substances which invariably act as poisons if given even in a comparatively moderate quantity; such as cantharides, etc.

Symptoms.—The symptoms produced by these different classes of poisons will vary greatly, and must be separately alluded to.

1. **Mineral Poisons.**—The symptoms produced by the ingestion of a mineral poison are usually the symptoms of violent irritation and inflammation of the mucous membrane of the alimentary canal. The tongue, therefore, presents more or less evidences of deficient secretion, and is dry, while the throat is sore, and the pharynx inflamed, there being at the same time all the ordinary evidences of violent gastritis. There is also vomiting with frequent and violent retching, besides which, if the inflammation of the stomach progresses, it may result in perforation and all the usual symptoms of peritonitis. As these symptoms gradually increase, cold sweats come on, and in a variable period the patient dies.

2. **Vegetable Poisons.**—The symptoms of vegetable poisoning are generally excessive narcotism, and all the symptoms of congestion of the brain, as loss of sensation, vertigo, dizziness, loss of vision and hearing, headache, snoring or stertorous respiration, loss of consciousness, coma, and all the symptoms of compression of the brain.

3. **Animal Poisons.**—The symptoms of the various animal poisons will depend very much, both in their violence and character, upon the nature of the articles taken. As a general rule, however, it may be stated that there is in these cases a disposition to vomit, accompanied by all the other symptoms of gastric and intestinal irritation or inflammation, while it is not unusual for these animal poisons, when not sufficiently active to destroy life, to be followed in certain constitutions by the development of skin disease, etc. etc.

Treatment of Poisons in the Stomach.—The indications for the treatment of poisons in the stomach are—1. To evacuate the organ. 2. Where this cannot be accomplished, or after it has been accomplished, if there is any reason to suspect that a portion of the poisonous matter has remained behind in the stomach or bowels, to employ proper antidotes. 3. To get rid of any portion which may thus have passed into the bowels, even after the administration of the antidote, by means of brisk and active purgation. 4. To combat any effects of the poison which may occur notwithstanding these measures, these effects being generally found either in inflammatory action in the mucous coat of the stomach, as in the case of the mineral and animal poisons, or in narcotism of the brain, as in the case of certain vegetable poisons.

The means to be employed in carrying out these various indications differ materially in accordance with circumstances. Thus, the simplest manner in which the first indication may be accomplished, and the contents of the stomach evacuated, is by means of emetics, and as these are sometimes demanded with great promptness, it is as well to remember those that are most likely to be found under ordinary circumstances, the simplest and most readily and speedily obtainable of which is dry mustard, salt, and warm water, a teaspoonful of the ordinary table mustard and a tablespoonful of salt being put into a tumblerful of lukewarm water, and drank off by the patient at a draught, after which the throat may be tickled with the finger or a feather with the view of exciting more prompt emesis. This substance generally acts with great promptness and efficiency. Another article which is applicable under these circumstances, particularly in the case of mineral poisons, where it acts not only as an emetic but as an antidote, is one which is also readily obtainable, though not now found so generally in houses as formerly, namely, common lamp oil; few persons being able to drink a tumblerful of it without having prompt emesis induced, while if it should not vomit it will yet sheathe the coats of the stomach from the action of acrid substances. Powdered ipecacuanha or powdered alum, if either can be obtained, is an excellent emetic, and may be administered in the dose of a teaspoonful every ten minutes, warm drinks being freely given in the interval until the desired effect is produced. Sulphate of zinc may also be resorted to in doses of half a scruple; or tartar emetic in doses of from two to five grains; sanguinaria, or bloodroot, in doses of a scruple; or lobelia or tobacco, though these articles should be cautiously given and carefully watched, lest the injury ensuing from their depressing and prostrating effect be no less than that resulting from the poison itself. The effects of the tobacco can be obtained either by giving it internally or simply (and this is preferable)by macerating the leaf, and binding it upon the skin at the pit of the stomach.

But a more certain mode of thoroughly evacuating the stomach is by the use of the stomach-pump and œsophageal tube, which should be passed into the stomach so as to remove its contents, as hereafter described.

Having thus gotten rid of as much of the poisonous matters as possible, the next duty of the surgeon is to resort to proper antidotes; these, of course, varying according to the nature of the poison, as each one has its appropriate and more or less efficient antidote. After thus neutralizing the effects of irritating poisons, the gastritis, etc. should be treated on general principles.

Antidotes for Poisons in the Stomach.—1. **Arsenic.**—The antidote for arsenic is albumen or gluten, which may be conveniently administered in the form of the white of eggs, or of flour and water, or lightly calcined magnesia, which should be given very freely, the albumen forming with the arsenic a comparatively insoluble and innoxious compound which may be subsequently removed from the alimentary canal by emetics and purgation. The albumen, however, though it should always be resorted to if other means are not at hand, is not nearly so efficient an antidote for arsenic as it is for corrosive sublimate, and the surgeon should therefore, if it be in his power, resort at once, in the case of arsenic, to the hydrated sesquioxide (peroxide) of iron, which is usually kept by the apothecaries ready prepared, and may be promptly made,* and which is the most efficient antidote for arsenic known.

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* See U. S. Dispensatory.

2. **Corrosive Sublimate.**—The best antidote for corrosive sublimate, as already stated, is albumen, though gluten, milk, or Peruvian bark may also be resorted to if albumen cannot be obtained. Any of these articles, to be thoroughly useful, should be given freely, and followed by the use of emetics and purgatives.

3. **Nitrate of Silver.**—For nitrate of silver the antidote is common table salt.

4. **Salts of Lead.**—For the salts of lead the proper antidote is diluted sulphuric acid, which forms with them, by a chemical reaction, the sulphate of lead, this being an insoluble compound. If, however, the salt of lead taken is the carbonate, the sulphuric acid should be cautiously given, and some means employed to prevent distention of the stomach from the carbonic acid gas, which will be rapidly evolved.

5. **Salts of Copper.**—In cases of poisoning from the salts of copper, the antidotes recommended are albumen, oil, etc.; but as the compounds thus formed are by no means perfectly insoluble, resort should afterward be had to purgation and emetics.

Vegetable Poisons.—Among the substances derived from the vegetable kingdom, the most common source of poisoning is the narcotics. In case of suspected poisoning from any of these substances, the first thing to be done is to empty the stomach, and this will be performed most efficiently by means of the stomach-pump; but if that is not at hand, or while waiting for it, prompt emetics may be given. The stomach having thus been properly evacuated, the next indication is to purge with a view of removing any of the substance which has passed into the bowels. In order to obtain full benefit from this treatment, the purge given should be an active one, as elaterium, gamboge, large doses of calomel, or similar prompt and efficient drastic cathartics. After having removed from the stomach all of the drug that can be obtained, and while waiting for the operation of the purgative, the effect of any portion of it which may have previously been absorbed should be counteracted by keeping up the activity of the brain until the sedative influence of the poison shall have passed off. This object may be effected by stimulating measures of various kinds, all of which should be steadily persevered in, as it is an established fact, that if the activity of the brain can be kept up for six or eight hours, in a case of narcotic poisoning from an article like opium, the patient will generally recover. A very good mode of carrying out this indication is by stimulating the nerves of the skin, and the simplest manner in which this can be effected is by switching the patient well by stripping him and striking him round the legs with a switch. The same end may be effected by the application of cold; either by leading him up and down a cold room, or giving him every fifteen or twenty minutes a shower-bath, or throwing a bucket of cold water over him; but this treatment should be cautiously practiced, for if the cold is carried so far as to produce its sedative effects, it will only add to the power of the drug. If, however, all these means seem to fail, the surgeon should not despair, as he has yet a resource which, in skillful hands, has saved life, and that is, to attempt to keep up the action of the brain by the galvanic battery, the most convenient form of which is to be found in the electro-magnetic machine, already alluded to.

Mineral Acids.—In the case of poisoning by the mineral acids, the antidote is to be found in the free use of the alkalies, avoiding, however, the carbonated alkalies on account of the distention which would result from the consequent evolution of carbonic acid gas.

In the case of oxalic acid, a vegetable acid which is sometimes a source of poisoning, the most serviceable antidote is lime, which may be obtained from a piece of chalk, or by scraping the ceiling of a room, and which forms with the oxalic acid an exceedingly insoluble compound.

In all cases of poisoning in which the substance used is acrid or corrosive in its nature, the indication to follow the use of the antidote by free mucilaginous drinks is a clear one, as they sheathe the mucous coat of the alimentary canal, and facilitate the action of the cathartic which is to be subsequently employed.

§ 3.—Extraction of Noxious Substances from the Stomach, through the Oesophagus.

The introduction of the œsophageal catheter, and the extraction of any substance capable of passing through its channel, is so simple an operation as to require but a few words.

Operation.—After placing a plug between the back teeth, so as to protect the fingers or the tube from being bitten by the patient, pass the forefinger of the left hand to the root of the tongue, and gently depress this organ. Then pass the catheter rapidly backward till it reaches the back of the pharynx, when, if the resistance that it meets with is not sufficient to depress its point, turn it down by the forefinger previously introduced. By carrying the point of the catheter toward either half arch, there will be little risk of introducing the catheter into the larynx, as the latter will be closed in consequence of the gagging induced by the presence of the finger in the pharynx. The introduction of the liquid, when it is necessary, to wash out the stomach, may then be effected by the stomach-pump, Plate XXX. Fig. 1, or by alarge rectum syringe. In withdrawing the catheter, its free end should always be closed by the finger, in order to prevent the escape of any drops of liquid into the trachea.

Remarks.—The performance of the operation of introducing the stomach-tube is so simple an affair that the evacuation of the contents of the stomach has more than once been done by a good hospital nurse. Within about fifty years, the extraction of poisons from the stomach, except by emesis, was, however, an operation quite unknown, until Physick, of Philadelphia, employed the now well-known stomach-tube, or œsophageal catheter, the benefits resulting from which have been so great that the profession in the United States may well be jealous of the credit of the invention and application of such a simple contrivance. In support of this assertion, I would mention the following facts: In the *American Medical Recorder*,* Matthews published a paper, in which he showed, very satisfactorily, the origin of this instrument, Physick, in 1800, having recommended it in his annual lectures in the University of Pennsylvania. Dorsey, who was in Paris in 1803, also states that he had a gum-elastic tube or catheter, made to Physick's order, for the purpose of evacuating the contents of the stomach, the length of which was so great as to excite considerable curiosity among the Parisian manufacturers of catheters, who could not divine for what purpose it was intended. In 1809 this instrument was employed by Dorsey,† and by others subsequently, an indefinite number of times. From a claim afterward made for the priority of this invention by Alexander Monroe, Jr., of Edinburgh, it seems that this gentleman had also conceived the same idea, and in an inaugural thesis, published in 1797, proposed similar means for extracting poisons, though he does not appear to have ever brought his suggestions into practice. Physick, though admitting at a later period the coincidence of the suggestion, always stated his ignorance of the thesis in which it was published, and, being the first person who had one constructed and employed, is certainly entitled to the credit of the operation, though willing to share the originality of the suggestion with another.

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* Am. Med. Recorder, vol. x. p. 322. Philad., 1826.

† Eclect. Repertory, October, 1812.

In the paper advocating the claims of Physick, will also be found a reference to the apparatus of Ewell, of Washington, as proposed in 1808, and of Jukes, of London, who contrived similar means in 1822, as well as the testimonials of the distinguished practitioners of that period, who, by common consent, seem to have awarded the merit of the original manufacture and application of the tube to Physick, he having, in the paper referred to, also furnished drawings of the stomach-pump to which it was adapted.

§ 4.—Stricture of the Oesophagus.

Pathology.—The analogy existing between strictures of the œsophagus and those of the urethra has always attracted the attention of surgeons when referring to this complaint. From the difference, however, which exists between the surrounding tissues in these two structures, a special description of the effects of the complaint, as developed in the œsophagus, is essential to a correct appreciation of the value of the various modes of treatment proposed for its relief.

The condition of the œsophagus, under the various causes producing stricture, is very varied; but, however excited, the constriction will generally be found to exist either near the upper or lower extremity of the tube, and to be due to certain deposits around, or changes in the mucous coat of the canal. Sometimes this coat is simply thickened, though it has also been found to be decidedly hypertrophied. When the stricture has existed for some time, or has commenced in the areolar coat of the œsophagus, the induration of the part is so marked as to present a mass closely analogous to scirrhus, while it has occasionally been found to have changed or entirely destroyed the ordinary characters of both the mucous and muscular coats, thereby rendering it difficult to decide in which tissue the disease had commenced.*

The extent of a stricture in the œsophagus is very variable; usually it is not more than a few lines, though it may reach to the length of several inches. At the seat of stricture there is often found a central contraction, or bandlike thickening, above and below which the indurated part is less constricted; while the portion of the canal immediately around the seat of the stricture has been known to be dilated into a pouch capable of holding a quart of liquid. Below the stricture, the œsophagus is occasionally more contracted than natural, and its parietes are also found to be thicker than in the normal condition. Frequently, on the contrary, it has presented no marked alteration. Ulcerations have also been found in the strictured portion of the canal, though they are believed to be more common above it, either in consequence of the particles of various substances remaining in the dilated portion, or from the efforts of the muscular coat of the canal to eject them, inducing increased inflammatory action.

In many instances, the adjacent lymphatic glands are either engorged or degenerated, and when the stricture has been seated in the neighborhood of the thyroid gland, the latter has been seen to be either hypertrophied, or very materially changed in its structure. In some instances, adhesions have formed between the posterior face of the trachea and the front of the œsophagus, or between the latter and the carotid artery, or the aorta, under which circumstances, a perforation of the œsophagus at these points is inevitably fatal.

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* Dictionnaire des Sciences Médicales, tome xxi. p. 397. Paris, 1840.

From this statement of the changes in the structure of the part, every surgeon must see the dangers attending any attempt to overcome old strictures of the œsophagus, and he should, therefore, be especially cautious not only in his prognosis, but also in the employment of the various means that have been suggested for the relief of the complaint.

The operations that have been recommended for the cure of œsophageal contraction consist in dilatation of the stricture, in the absoption or destruction of the diseased substance, or in a direct incision through the constricted portion, so as to destroy the permeability of the canal.

I.—Dilatation of the Stricture.

Instruments.—Without entering into a description of the various instruments that have been suggested for the purpose of dilating the stricture, this account will be limited to the operation as accomplished by means of bougies. As originally suggested by Sir Everard Home, these bougies were made of waxed linen in the manner that will be referred to under the head of operations on the urethra, and being passed into the œsophagus, by the manœuvre directed for the introduction of the stomach-tube,* were either held for a few minutes against the seat of the disease, or gently pressed through the stricture, so as to dilate the canal as they advanced. The ordinary condition of these bougies, when made entirely of linen, does not, however, afford sufficient firmness to prevent the pressure upon them causing a lateral deviation of the instrument, in consequence of which the surgeon cannot tell accurately upon what point of the œsophagus his force is applied. An instrument which I have found to answer better, is one that was employed by Horner, of Philadelphia, and represented in Plate XXX. Fig. 6. It is formed by rolling a piece of waxed linen, about three inches long, and cut bias so as to give it a conical shape, around the end of a flexible piece of whalebone, like that employed for the probang.

Operation.—After smearing the instrument either with molasses or oil, pass it into the seat of the stricture, and make gentle pressure at the obstruction until it yields, directing the point of the bougie to the part that seems most constricted.

Remarks.—In all attempts at dilating strictures of the œsophagus, it should be remembered that gentle and continuous pressure answer better than violent efforts. In fact, the principles that would direct the dilatation of a strictured urethra are also those which should guide the operator in relieving the similar condition of parts in the œsophagus. But very little force should therefore be employed in dilating œsophageal strictures, as the œsophagus about the seat of the stricture is very liable to dilatation, as well as to softening or ulceration; if then the bougie is made to bear too forcibly on such a point, perforation of the canal might ensue, and the patient be exposed to all the risks of suffocation or infiltration of the surrounding parts on the first attempt that is made to swallow liquids. In the lighter forms of permanent stricture, in which the tissues are not much changed, and in the spasmodic variety, dilatation presents many chances of success; but dilatation of strictures in the œsophagus, like those in the urethra, will prove but a temporary means of relief if the surrounding parts are much indurated.

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* See p. 287.

Under these circumstances, the application of caustic may be advantageous, if judiciously and carefully directed.

II.—Application of Caustic.

The caustic applied for the relief of strictures of the œsophagus may be either the Kali purum or caustic potash, or the nitrate of silver. From the difficulty of regulating the action of the potash, and the peculiar advantages resulting from the application of the lunar caustic to the mucous membranes generally, the latter is decidedly preferable. It may be employed in the following manner:—

Operation.—Pass a simple or unarmed bougie down to the stricture, and mark accurately the distance of the disease from the mouth. Then arm another bougie, by scooping a little hole in the end of the waxed linen, and fit in this a small piece of the nitrate of silver, being careful to fasten it accurately in its place, so that it may project a little beyond the level of the point of the instrument. Mark then upon this bougie the distance of the stricture from the teeth, as shown upon the former instrument, and, passing it rapidly to the seat of the disease, retain it in contact with the part from one to three minutes. On withdrawing it, examine the caustic, in order to judge how much has been dissolved, and if it is deemed to be too much, or such as might act upon the surrounding parts, cause the patient to swallow some strong salt and water, in order to neutralize it and prevent its continued action.

Remarks.—The application of the nitrate of silver in this disease is beneficial in two ways: 1st, by repeatedly creating a superficial eschar on the surface of the stricture, it gradually destroys it; and 2d, by allaying the irritability of the canal, by stimulating and modifying the action of its mucous membrane, thus doing much toward the radical cure of the complaint. After a few applications of the catheter, the simple bougie will often be found to pass readily, while the relief will be more permanent than that which ensues upon mere dilatation of the part, except in the spasmodic form of the complaint. It need hardly be said that the application of the caustic should be restricted to the diseased portion of the canal, by placing it in such a position in the bougie as will prevent its action elsewhere.

III.—Oesophagotomy.

Under peculiar circumstances, as when it is necessary to remove a foreign body from the canal, or when, in cases of impervious stricture, there is a necessity for the introduction of food in order to sustain life, it has been advised to open the œsophagus from the outside of the neck. Although a rare operation, and one which offers but slight chances of permanent relief in cases of stricture, this operation has been successfully resorted to, an example of which has been reported by Taranget,* where the patient was thus nourished sixteen months.

Nearly equal success has, however, been obtained by a direct opening into the intestines or stomach, while the injection of nutritive substances into the rectum presents a very good substitute for such hazardous means of treatment.

In a paper by Watson, of New York, may also be found the history of a case in which the patient's life was considerably prolonged by this operation, though he ultimately died from the extension of the disease to the bronchia. Œsophagotomy is, however, very rarely resorted to, having only been performed five times, two of which were reported more than a century since.

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* Dict. des Sciences Méd., tome xxi. p. 412.

Three modes of operating have been suggested, to wit: that of Guattani, who incised the left side of the neck, and dissected to the œsophagus, between the trachea and the sterno-hyoid and thyroid muscles, Plate XXXVI. Fig. 6; that of Eikholdt, who made his incision between the two origins of the sterno-cleido-mastoid muscle; and that of Boyer, who cut between the sterno-hyoid and sterno-mastoid muscles. Boyer only opened the œsophagus for the extraction of foreign bodies, and was, therefore, guided by the projection of the substance. Giraud and Vacca Bellingheri first introduced a silver sound, so as to render the œsophagus prominent; and Begin trusted entirely to the anatomical relations of the part.*

Without further reference to these various plans of treatment, it may suffice, as illustrative of a successful method of operating, to state the manner in which it was accomplished by Watson, in February, 1844.

Operation of Watson, of New York.—The patient being placed on a cot near a window, with his back well supported by pillows, and his head thrown gently backward, the incision was commenced on the left side of the neck, midway between the os hyoides and the upper border of the thyroid cartilage, just in front of the sterno-mastoid muscle, and carried down parallel with the edge of this muscle, to within an inch of the sterno-clavicular articulation, dividing the skin, superficial fascia, and platysma-myodes muscle.

A second incision, about an inch in length, was now made, nearly parallel with the upper edge of the thyroid cartilage, terminating posteriorly at the upper extremity of the first and extending to the same depth. After turning up the flap at the angle of these cuts, a glandular tumor, about the size of a hazel-nut, was exposed and removed from among the layers of the deep fascia. It proved to be very hard, and contained a yellowish concrete pus in the centre. The dissection being then continued through the deep fascia, the omohyoid muscle was exposed and divided; the superior thyroid artery brought into view, secured by two ligatures, and divided between them and the loose connective tissue between the carotid and the trachea, separated by the handle of the scalpel until the lower portion of the pharynx and part of the œsophagus were fairly exposed, this structure being put upon the stretch at every effort of the patient to swallow. The edges of the wound being then dilated by curved spatulæ, an attempt was made to seize and puncture the wall of the pharynx; but owing to the difficulty of accomplishing it without endangering other parts, a silver catheter was introduced through the mouth to the stricture, and, its point being cut upon, the œsophagus was opened.

On passing an instrument into the opening, the seat of obstruction was found to be just below the incision but within reach of the finger; and as there was danger of wounding the ascending thyroid artery in an attempt to divide it from within, it was found necessary to open it from without. In order to obtain room, the sterno-mastoid muscle was therefore divided transversely, and the upper border of the thyroid gland turned down.

The recurrent nerve being now brought into view, one of the branches of the superior thyroid artery was divided as it entered the gland, giving rise to the only hemorrhage that required attention during the operation; and this being arrested, the division of the stricture was effected by an incision through it of at least an inch and a half in length, the obstruction depending apparently on a simple induration and contraction of the part not over five or six lines wide. A stomach-tube being then introduced through the wound, wine and arrow-root were administered. This tube was next secured to the side of the head by its free extremity, the transverse portion of the wound closed by a single suture, and the balance allowed to remain open. At the end of six days, the tube being removed, a second one was introduced through the nostril, down through the stricture, and worn twenty-five days, the wound being closed by adhesive plaster. Several changes in the catheter being made from time to time, the patient continued wearing them for nearly seven weeks, the wound having healed around it. At the end of this period, the tube was withdrawn on account of the irritation in the throat, the obstruction in the œsophagus reappeared, so as to require the reopening of the wound in the neck, and the patient died about three months subsequently.

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* Malgaigne, Philadelphia edit., p. 376.

Remarks.—That Œsophagotomy is an operation requiring much deliberation on the part of an operator, in connection with its results, is a point that has long been regarded as settled, and that it is a formidable operation, must, it is thought, be apparent to all who read the account furnished by Watson. The question therefore naturally presents itself, whether, in order to prolong life, it may be right to advise a patient to submit to it. Deeming the relief afforded by it dearly purchased at the risks of the operation, except in very skillful hands, I cannot but think that the danger of making an opening directly into the stomach, as subsequently referred to by Dr. Watson, in the paper before quoted, is certainly not greater than that incurred in œsophagotomy. The number of instances in which wounds and openings into this organ have not proved fatal will, on examination, be found to be much larger than might at first sight appear probable. In addition to those which I have mentioned, there is also one reported by Watson,* as having been seen by Archer, of Maryland, in which the stomach was opened more than two inches by a wound with a knife, and the wound so well sewed up by an old soldier with an awl, needle and thread, (the stitches being only through the skin,) that the patient recovered, though an abscess of some size formed in the groin on the ninth day, as the result of the wound in the stomach, and was afterward evacuated. The well-known case of St. Martin, and the case reported by Etmüller, where a fistula in the stomach remained open ten years, together with numerous other facts collected by Watson's extended research and stated in his paper, also warrant his assertion that an opening into the stomach is an operation that is justifiable in urgent cases of stricture of the œsophagus, and probably quite as favorable to the recovery of the patient as that of œsophagotomy. In support of his suggestion, Watson quotes† several cases in which fistula communicating with the stomach have continued for years, food being discharged at the opening after each meal; while on three different occasions surgeons have incised the stomach for the removal of foreign bodies, and the patients recovered. The removal of a teaspoon by opening the intestines, as was successfully done by Samuel White, of Hudson, New York; the excision of a part of the spleen by Powell, of Kentucky; the wound in the stomach reported by Ashby,‡ of Alexandria, and the cases of Dugas, of Georgia, and Hart, of Mississippi, as well as the free incisions made in the peritoneum in ovariotomy, are all instances of the tolerance of patients under wounds of this region, and may certainly be deemed sufficient to justify a surgeon in opening the stomach in the extreme cases of impassable stricture in the œsophagus. But though these cases hold out the prospect of success in the execution of similar incisions, no one, it is presumed, would attempt gastrotomy with the view of nourishing a patient, unless specially urged thereto by the peculiar circumstances of the case.

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* Am. Journ. Med. Sciences, vol. viii. N. S. p. 327, 1844.

† Ibid., p. 309, 1844.

‡ Virginia Stethoscope, vol. i. p. 660.

In the event of the distribution of property, or to accomplish some great moral good, or in order to fulfill an important duty to another, a patient might desire to prolong life, if possible, even for a few weeks, and under such circumstances, it may become imperative on a surgeon to resort to such means as will enable him to obtain the desired time.

CHAPTER VI.

OPERATIONS DEMANDED FOR THE RELIEF OF DEFORMITIES IN THE NECK.

THE affections of the neck which lead to such deformities as demand direct surgical interference in the way of an operation, being due usually to contractions either of the skin, fascia, or muscles, it is generally necessary to employ some mechanical means either to extend the contracted tissue, or to prevent the reappearance of the deformity after the operation. In most instances, therefore, the assistance to be derived from proper dressings and mechanical contrivances should be remembered, and proper preparations made for their application before any incision is commenced.

The deformities of this region may be subdivided into those affecting the skin and fascia, which are usually the result of burns, and those confined to the sterno-cleido-mastoid muscle, the latter being consequent on various causes.

SECTION I.

DEFORMITIES FROM BURNS.

The destruction of the skin and areolar tissue, consequent on burns of this region, occasionally produces such a contraction of the features as results in hideous deformity, or in an inability on the part of the patient to perform many of the motions of the neck, thus interfering with the action of the head, and preventing the proper execution of such movements as are required in various daily occupations. Among the most serious of these injuries is such an adhesion of the skin of the neck to that of the chest as results in an inability to elevate the head, or such a contraction of the integuments about the chin as renders it impossible to close the mouth, or draw up the lower lip. Under these circumstances, operative surgery is capable of adding much to the comfort and happiness of the sufferer, and, even in very marked cases, has produced results that have been of the most gratifying kind.

In order to appreciate the value of the operations that have been, at different periods, suggested for the relief of deformities from burns, whether on the neck or elsewhere, it is important that attention should be given to the changes produced in the tissues affected—page 421, vol. i.—as well as to the almost unvarying tendency of the structure involved to reproduce similar contractile tissue, unless the diseased portion is removed, and the space filled

PLATE XXXIII.

OPERATIONS PRACTICED ON THE NECK.

Fig. 1. A view of the Lymphatics, together with the Blood-vessels and Nerves found on the side of the Neck. 1. Carotid artery. 2. Par vagum nerve. 3. Internal jugular vein. 4. Subclavian artery. 5. Subclavian vein. 6. Brachial plexus of nerves. 7. Lymphatic vessels and glands. 8. Phrenic nerve. 9, 9. Sterno-hyoid and sterno-thyroid muscles. 10. Thyroid gland. 11. Superior thyroid artery. 12. Lymphatic gland, situated on the temporal vein. 13. Lymphatic, at the angle of jaw, imbedded in the parotid gland, and liable, when diseased, to be mistaken for an enlarged parotid. 14. Three superficial lymphatic glands on the course of the sterno-cleido-mastoid muscle. 15. Deep-seated lymphatic at the lower part of jaw. 16. Facial artery and vein. 17. Lymphatic gland in advance of the submaxillary. 18. Submaxillary gland. 19. Three superficial lymphatics behind the sterno-mastoid muscle. 20. A large lymphatic gland situated outside, but adjacent to the sheath of the blood-vessels. 21. A chain of lymphatic glands which extend from the side of the neck to beneath the clavicle between the trapezius and sterno-mastoid muscles. All the lymphatic glands above referred to are the occasional seat of tumors in the neck.

After Bonnamy and Beau.

Fig. 2. Effects of a Cicatrix from a Burn of the Neck. *After Nature.*

Fig. 3. Myotomy as practiced for the relief of Torticollis. 1. Right hand of the surgeon in the act of inserting the tenotome beneath the skin. 2. His left hand raising the muscle. *After Bourgery and Jacob.*

Fig. 4. A view of the position and development of a Carotid Aneurism. 1. Common carotid artery. 2. Aneurismal sac. 3. Par vagum nerve displaced by the tumor. 4. Hypo-glossal nerve forced downward and forward by the growth of the tumor. 5. Internal jugular vein. 6. Sterno-cleido-mastoid muscle and skin drawn to one side by 7, a curved spatula.

After Nature, and John Bell.

Fig. 5. Ligature of the Arteries about the Neck. **L.** Ligature of the lingual artery. 1, 1. Ligature passed beneath the artery. 2. Stylo-hyoid muscle. 3. Hypo-glossal nerve. 4. Digastric muscle. 5. Incision through the skin and fascia. 6. Platysma-myodes muscle. *After Bourgery and Jacob.*

C. Relative position of the parts concerned in the Ligature of the Primitive Carotid. 1. The upper end of the incision. 2. The skin and fascia. 3. An abnormal arterial branch from the arch of the aorta to the pharynx, running parallel to the carotid artery. 4. The common carotid. 5. Descendens noni nerve. 6. Par vagum. 7. Internal jugular vein drawn aside. 8. Sterno-cleido-mastoid muscle held back. 9. A blunt hook. *After Auvert.*

A. Ligature of the Axillary Artery. 1, 1. Line and extent of the incision. 2. Pectoralis major as divided. 3. The axillary artery. 4. A ligature placed beneath it. 5. Axillary vein. 6. Brachial plexus. 7. Pectoralis minor muscle.

After Bourgery and Jacob.

Plate 53

Fig. 1

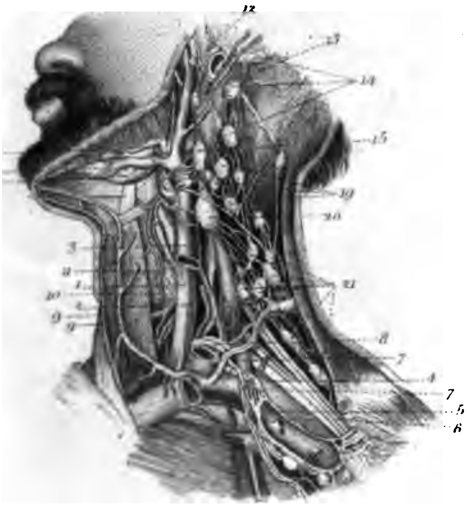


Fig. 2

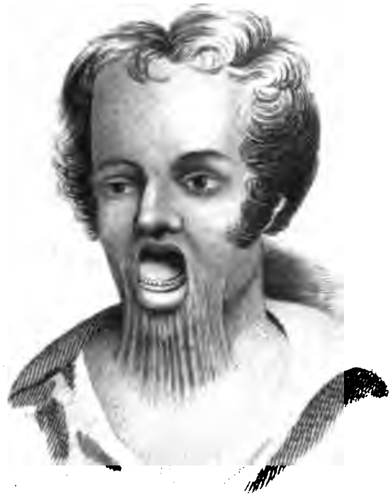


Fig. 3

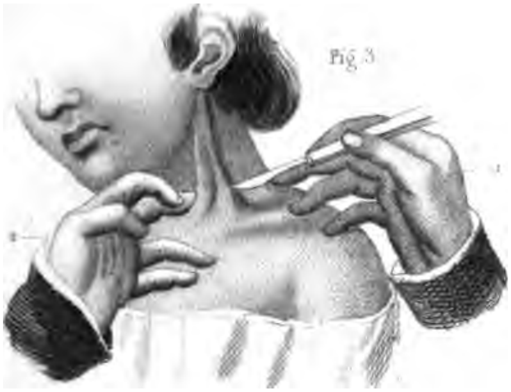


Fig. 4

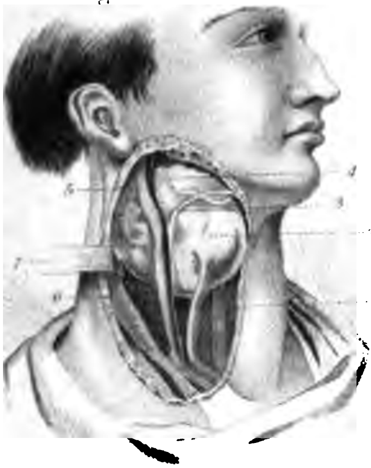
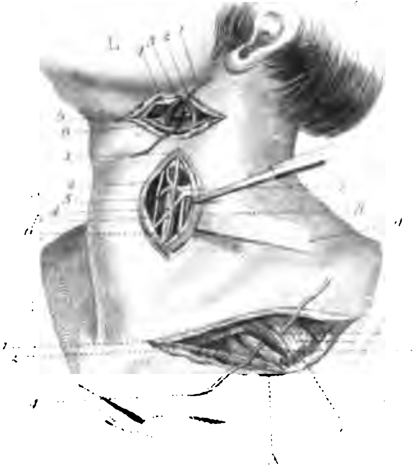


Fig. 5



by healthy structure, the latter being usually obtained by some means similar to those before referred to in connection with the class of plastic operations upon the face.

The following operation may serve as a type of those usually performed:—

Operation of Mutter, of Philadelphia.—The patient, a young woman aged twenty-eight years, had been burned twenty-three years previously, upon the face, throat, and upper part of the thorax, from her dress taking fire. She had been unable to throw her head to the left side, or backward, or to close her mouth for more than a few seconds during the whole time. The right eye was also drawn down some distance below the other, and when an effort was made to turn the head, the eye became closed. The chin was drawn to within one inch and a half of the top of the sternum, and this place was so filled up by the cicatrix, that no depression existed in front of her neck.

Operation.—The patient being placed in a strong light, on a low chair, with her head thrown back as far as possible and sustained by an assistant, an incision was commenced on the outside of the cicatrix, in the *sound skin*, and carried across the throat into the *sound skin* on the opposite side. This incision penetrated through the integuments as near the centre of the cicatrix as possible, and was about three-fourths of an inch above the top of the sternum, the object being to get at the origin of the sterno-cleido-mastoid muscle, which, in consequence of the long-continued flexion of the head, was not more than three inches long.

After exposing the muscles, a director was passed under that of the right side, and both its origins divided. The sternal origin of the left muscle was next divided in a similar manner, when it was found that the head could be placed in a proper position. The elevation of the chin now left a wound six inches long by five and a half wide, to fill which a flap was formed from the shoulder by an incision which, commencing at the left end of the wound in the neck, extended downward and outward over the deltoid muscle, so as to furnish an oval piece of integument six inches and a half long by six wide, which was left attached by its base at the upper part of the neck. On dissecting this flap free from the shoulder, it was twisted by a half turn on its pedicle, brought round into the wound on the front of the neck, and retained there by numerous twisted sutures and adhesive strips; after which the wound on the shoulder was closed as far as possible by sutures and strips. The head being now carried backward, and maintained in this position, the patient was put to bed, and union by the first intention took place throughout the entire wound, with the exception of one small point which healed by granulation.*

Some additional steps relieved the eye and mouth; and twelve months subsequently the cure of the patient was complete.

SECTION II.

TORTICOLLIS, OR WRY-NECK.

By the term **Torticollis,** or **Wry-Neck,** is usually designated such distortion of the head, from muscular contraction, as brings the back part of it forward, downward, and sideways, so as sometimes to turn the chin upward and over the opposite shoulder, the former being raised in proportion as the occipital bone is drawn down. Although disease of the vertebræ, injuries of the skin, or other causes may create this deformity, the present account will be limited to the consideration of such cases as are mainly dependent on an unnatural and permanent contraction of the sterno-cleido-mastoid muscle.

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* Am. Journ. Med. Sciences, vol. iv. N. S. p. 69.

Among the various causes that excite this deformity, there is sometimes seen an unnatural contraction of one muscle, in consequence of the partial paralysis of that of the opposite side, the contracted muscle being generally felt like a tense prominent cord, or, if not distinct, readily made so by any effort to turn the head toward the sound side. To relieve this condition of things, and bring the chin again to its natural line, the operation of myotomy, or the subcutaneous division of the muscle or its tendon, and the application of a suitable apparatus for making moderate extension of the muscle and preventing the future contraction of the new tissue formed in the line of the incision, is especially calculated.

When, after an examination of the origin of the complaint, its existence is found to be mainly due to a contraction of the muscle, stimulating frictions, electricity, galvanism, and manual efforts to restore the head to its proper position may be first resorted to; but when, after a trial of these and similar measures, little progress is made toward a cure, the division of the muscle or its tendon will materially expedite the result.

Various modes of operating have been suggested by different surgeons, in order to accomplish the accurate yet safe division of a muscle which is known to be so closely connected with important blood-vessels and nerves throughout most of its course, as the sterno-cleido-mastoideus. These suggestions differ, however, mainly in the shape of the knife or in the point at which the muscle may be most advantageously incised; but as the subcutaneous division is preferable to the old plan of dissecting down to the muscle, the description of the operation will be limited to this mode of operating.

Operation of J. C. Warren, of Boston.—A little girl, nine years of age, much distorted, was operated on as follows:—

The head being supported and the muscles rendered tense, a narrow sharp-pointed bistoury was passed flatwise between the skin and the sternal origin of the muscle, from without inward, Plate XXXIII. Fig. 3, and the edge of the knife being then directed upon the muscle, its division was accomplished. The knife being now withdrawn and again entered at the same orifice, was carried in front of the clavicular origin of the muscle, which was divided in a similar manner. Bandages, similar to those employed in the preceding case, were then applied; and two months after the operation her head was so nearly straight that the deformity was not perceptible to ordinary observers.*

John W. Brown, of the Boston Orthopedic Infirmary,† after dividing the muscle, employs a simple yoke to which bands from a cap are attached, and has published, in a paper on the subject, an expressive drawing of the apparatus, of which my present limits forbid a description. In Plate XXXV. Fig. 14 may, however, be seen a contrivance which I have found to be well adapted to the object in view, and which I employed successfully in two cases on which I operated, by dividing the muscle from before backward.

Remarks.—Having formerly followed closely the practice of Guérin in Paris, and also noted the results of such patients as I have operated on, I am induced to think that more or less benefit will be derived from the section of this muscle in most of the cases which are unaccompanied by deformities in the bones, while in those solely dependent on a contracted condition of the muscle a perfect cure may be anticipated. Of the various modifications suggested in the performance of the operation, there are none of great consequence; though the section of the muscle from before backward is, I think, the safest. In operating in this manner, attention should be given to the position of the external jugular vein as it approaches the subclavian vein; and when the knife is upon the muscle, the division of the latter will be most safely accomplished by holding the knife firmly against the muscle, and causing the latter to press against the knife, by carrying the head in such a position as will make the muscle prominent. A narrow straight bistoury, or a knife like that in Plate XXXV. Fig. 13, makes so small a wound that, if care is taken to exclude the air, but slight inflammation will ensue upon the operation.

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* Boston Medical and Surgical Journal, vol. xxv. p. 124.

† Idem. vol. xxvi. p. 58.

Much of the success of this operation will, however, depend on the proper employment of mechanical means subsequently. The apparatus—Plate XXXV. Fig. 14—before referred to is simple and efficient; but a nightcap and bandage, a tin frame, or any other contrivance which will enable the surgeon to draw the head into the proper position, will often be found to answer quite as well. The division of the muscle, it should be recollected, only facilitates the cure; the mechanical treatment accomplishes the most important part of it, and also prevents that reproduction of the deformity which is likely to ensue, when means are not taken to obviate it.

CHAPTER VII.

OPERATIONS FOR THE REMOVAL OF TUMORS OF THE NECK.

SECTION I.

THE ORDINARY POSITION OF TUMORS.

THE large number of lymphatic glands found in the neck, and the knowledge of their ordinary position, render a diagnosis of many of the adenoid tumors of this part more easy than might at first sight be supposed. According to the views of Allan Burns, nearly all the glandular tumors of the neck may be referred to two classes, and arranged solely in accordance with their position—as 1st, those which are without, and 2d, those which are within the fascia, the existence of either being recognized by their mobility, or the ease with which they can be drawn from their ordinary position.

On examining the structures mainly concerned in this class of tumors, it will be found that the great chain both of the superficial and deep-seated lymphatics of the neck follow the course of the superficial and deep-seated veins, Plate XXXIII. Fig. 1. In the healthy condition, these glands are for the most part flattened and oval, varying from two to nine or ten lines in length. Of the superficial glands there are, between the skin and the insertion of the sterno-mastoid muscle, from four to six; in the interstice between the clavicular origin of the sterno-cleido-mastoid and the anterior edge of the trapezius, just above the clavicle, and bordering on the external jugular vein, are half a dozen; between the skin and the parotid gland there are two, one above or near the zygoma, and the other below near the angle of the jaw. Disease and enlargement of the latter are very apt to be mistaken for an affection of the parotid itself. In the early stages of this tumor, its movable character will, however, prevent such an error in connection with the parotid. Around the submaxillary gland, especially at its anterior and posterior extremities, there are eight or nine, and in it as well as in the parotid, are lymphatic vessels and smaller glands which are the primary points from which the disorder of these structures originates. The deep lymphatic glands of the neck are also very abundant; they are placed along the sheath of the carotid artery and jugular vein, and between them and the anterior edge of the trapezius are about twenty. When enlarged, these glands project beyond the sterno-cleido-mastoid muscle at its posterior edge, and in the removal of some of them a section of the muscle may be required. Between the inferior edge of the thyroid gland and the sternum, on the trachea, are four, and a chain of them extends from these around the œsophagus, trachea, and blood-vessels toward the heart,* Plate XXXIII. Fig. 1.

Adenoid tumors, formed at the expense of the deep lymphatic glands of the neck, are exceedingly liable to contract adhesions, especially to the sheath of the vessels, so that their extirpation will involve these parts so directly as to lead to danger unless caution is exercised. As a class, these tumors are more fixed, and the finger cannot be passed around them in the same manner as is often the case in the superficial glands. When a tumor in the neck of a solid, or apparently semi-solid consistence, is seated nearly on a line with the upper portion of the larynx or toward the angle of the jaw, or close to the posterior edge of the sterno-mastoid muscle, and seems to elevate the muscle, or is rendered more movable by relaxing the latter, it will often prove to be directly over the course of the great vessels if not attached to their sheath. When a tumor in the neck is large, pediculated, or shows a tendency to extend and elongate the skin, so as to become pendulous, its attachments will generally be superficial. But if the size of the tumor is not large—say not larger than a lemon—if it is round or flat, hard, bosselated, and not easily moved, or excites doubts as to its mobility, especially if its attachment is near to and in the line of the sterno-cleido-mastoid, it may be taken for granted that it is deep seated. A small tumor not larger than a walnut, and apparently upon the edge of the sterno-mastoid muscle, and whose removal seemed to be a very simple affair, was undertaken by a well-known surgeon. Having noticed the liability to error of diagnosis in such cases, I was prepared for hemorrhage, and, in a very few minutes, was compelled to tie the internal jugular vein with two ligatures, the vein and sheath of the vessels being so adherent to the base of the tumor as to mislead the operator as to its actual position. So deceptive are the attachments of all tumors of the neck, that it has been justly said "that no one can tell how far he may be compelled to go in order to remove them, until he has completed the operation."

SECTION II.

OPERATIONS FOR THE REMOVAL OF TUMORS OF THE NECK.

In the treatment of the morbid condition of structures as varied as those connected with tumors in the neck, it must evidently be impossible to lay down any general mode of operating that would be applicable even to a majority of the cases that may be met with. Surgical writers have, therefore, generally been satisfied with furnishing directions in regard to the form of the external incision, or in recommending that in all operations for the removal of tumors, the skin should be cut so as to create as little deformity as possible, while, at the same time, the deep-seated attachments of the structure to be removed are freely exposed. In the neck, the latter recommendation is especially serviceable, as too much stress may be laid on the deformity likely to arise from the cicatrix. When compared with the increased difficulty liable to be caused by a limited incision, the inconvenience created by the deformity from a cicatrix does not deserve a moment's consideration. Wounds of the skin, it is well known, generally unite with great facility, while a free incision, by enabling the operator to see distinctly the structures upon which he is acting, will greatly accelerate the accomplishment of his object, and save the patient much unnecessary risk and suffering. From the importance of the parts connected with tumors in the neck, the first object of the operator should certainly be to accomplish the removal of the disease with safety and certainty, and nothing will aid this purpose so much as a free external incision; the subsequent dissection being, if necessary, more limited in its extent. The choice of the shape of an incision will also often exert considerable influence upon the success of the operation; and a brief reference to the adaptation of each of them to special cases may, therefore, prove serviceable.

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* U. S. Dissector.

The straight incision is especially applicable to the removal of small and superficial tumors, or those situated directly beneath the skin. The elliptical incision exposes a part more freely, and is chiefly resorted to when it is desired to remove an excess of integument, as in the case of a large or pendulous tumor. The V incision is more free, and adapted to tumors of moderate size, so situated as to render it necessary to insure the safety of particular parts; while the crucial or the T, and especially the former, will be found the best in all cases where the tumor is large, and likely to require a free dissection. But no matter what line of incision is selected, it is essential that the external or primary cut should extend at least to the very circumference of the base of the tumor, as seen through the skin, and in many instances it will be found advantageous to carry it a few lines beyond this point. After incising the skin, there are certain rules which are applicable to the removal of the majority of tumors, and the observance of which will prove highly useful to those who have yet to gain their experience. Thus Stevens, of New York, directs the operator first to cut down to the tumor before commencing its dissection; and, second, to remove the whole of the tumor, and nothing more.

It is also advisable that the dissection should be made by extensive cuts, by which is meant the sweeping motion of a good dissector, and not the hacking and pricking of tissue occasionally seen, the edge of the scalpel being directed as much as possible from those parts which it is important to leave untouched, whether they be in the tumor or in the healthy structure. In connection with the dissection conducted in the neighborhood of important organs, whether nerves, vessels, or muscles, he also directs that they should be drawn or put to one side by means of blunt hooks, the fingers, or forceps. When the principal portion of the tumor is removed, especially if it is of a suspicious character, the surgeon should endeavor to satisfy himself that no particle is left behind, lest it serve to reproduce the disease; and when any of the remnants are thus found, they should be removed either with the knife or scissors, the wound being left undressed until all the vessels are tied and the flow of blood arrested, when an effort may be made to heal it by the first intention.* On this latter point surgeons have always differed.

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* Malgaigne, Op. Surg. Philad. edit. p. 104.

PLATE XXXIV.

APPEARANCE AND POSITION OF SOME OF THE TUMORS SEEN ABOUT THE NECK.

Fig. 1. A large Cystoma of the right parotid region, caused by the development of a sebaceous follicle in consequence of a blow upon the part. Commencing as a lump the size of a nut, this tumor gradually increased to nearly the size of the head; gave exit at one time to sebaceous matter; had a broad base; was nearly immovable; had the veins enlarged upon its surface, and showed a small ulceration in front, from which fetid, acrid, and bloody sanies had escaped. As the tumor enlarged, the jaw became closed; sensation of the face diminished, and there were all the other symptoms due to pressure on the vessels and nerves of the part. The tumor differs in appearance from scirrhus of the parotid gland in its size and period of development. It was readily removed, and is represented as an example of one of the class of tumors of the parotid region not involving the parotid gland. *After Auvert.*

Fig. 2. Large Adenoid Tumor of the Neck dependent on degeneration of the lymphatic glands of the neck. Arising as a small swelling caused by an enlarged gland below the angle of the jaw, it gradually increased until it occupied the entire side of the neck, involving many glands, and reaching from above and behind the ear to below the clavicle, so as to turn the head to the opposite side. Its appearance was that of an irregularly lobulated mass: it was unaccompanied by pain, was perfectly firm and hard, and gave no sense of fluctuation at any point. Under the use of chloroform, it was successfully removed by Mott. *After Mott.*

Fig. 3. Appearance of an immense Adipose or Lipomatous Tumor of the Neck. This tumor was not painful; had no pulsation; was formed of numerous large lobes, with the superficial veins distended over them, and was attached to the neck by a large pedicle which extended from the angle of the lower jaw on the right side, down to the sterno-clavicular articulation, its weight being so great that the patient could hardly retain the erect position. The tumor was found to be covered by a strong capsule formed of the surrounding cellular tissue, and to have originated in a hypertrophy of the surrounding adipose tissue. *After Auvert.*

Fig. 4. A large Cystoma of the left Parotid and Submaxillary Regions, which was to the touch semi-elastic, unequally lobulated, and due to a chronic irritation of one of the sebaceous follicles, the duct of which had become closed, and thus caused a retention and degeneration of its secretion. *After Auvert.*

Plate 34.

Fig. 1

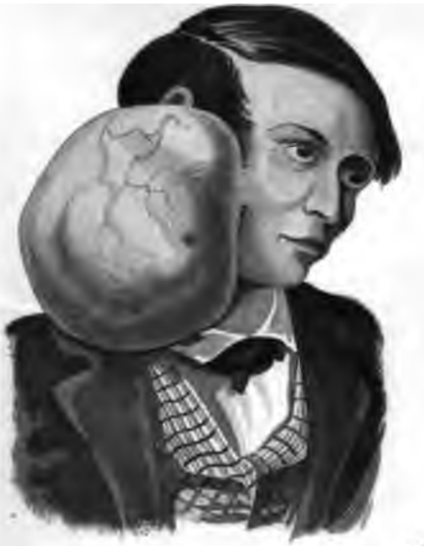


Fig. 2

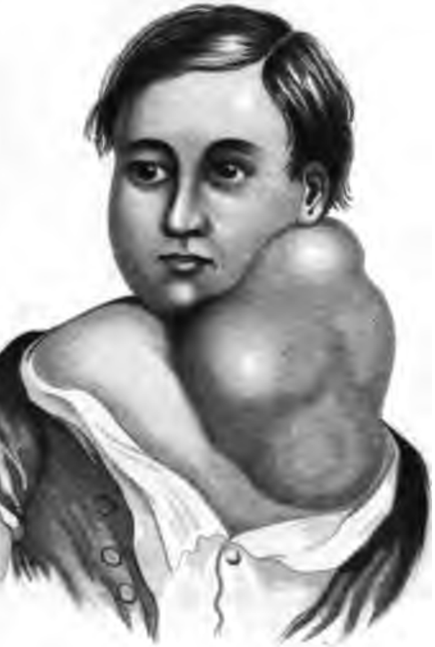


Fig. 3

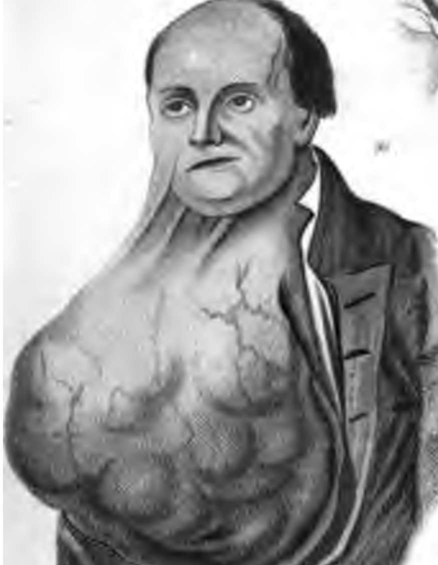
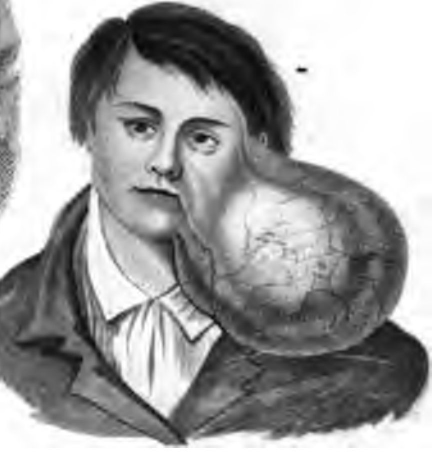


Fig. 4



In tumors of any size above that of a walnut, union by the first intention will not usually be possible, especially if ligatures have been required; and individual experience has rather led me to the observance of the practice of Physick, in the introduction of a little slip of linen at the inferior angle of the wound, so as to insure a vent for any pus that may be secreted. The surface of an incised wound generally unites without difficulty; but the deeper-seated parts are more obstinate, and in the neck it is especially important that pus should be prevented from burrowing, and that a free vent should be guaranteed it by other means than those furnished by bringing the ligatures out at the lower angle of the incision.

In the extirpation of tumors about the neck, Langenbeck proceeds as follows: He first makes a free division of the integuments, dissects the muscles from over the tumor, but avoids cutting through or injuring them if possible, thus making the tumor sufficiently movable, while, by preserving the muscles, he is enabled to know accurately the place of the chief blood-vessels. Then when the surface of the tumor has been cleared, its separation is to be commenced on that side which presents the least risk, or where the least considerable vessels are, and the dissection carried from thence toward the more hazardous portions. This distinguished surgeon has also recommended that the knife should not be introduced deeply where there are any large blood-vessels, but that the tumor should be strongly pulled outward, so as to separate it from the vessels, and put the connective tissue on the stretch. The latter recommendation will be found especially serviceable, and the operator will be well able to carry it out if he takes the preliminary step of passing a strong ligature deeply into any solid tumor immediately after incising the skin.

Directions like those of Langenbeck, though of a general kind, should be firmly impressed on the mind of the surgeon, when operating on tumors of this portion of the body, or indeed elsewhere. In every operation upon tumors in the neck, the operator should always be on the watch to prevent the entrance of air into the veins, and, when it occurs, immediately resort to stimulants to the nostrils, frictions, and artificial respiration, in order to restore the heart's action. But, though sufficiently useful as far as they go, these directions do not give such an accurate account of the best mode of overcoming the difficulties likely to be met with in the removal of tumors from the course of the great vessels of the neck as is desirable, and I have, therefore, made a selection of a few difficult cases, with a view of furnishing the best possible substitute for the individual observation of any young operator, viz., the experience of those whose skill and life-long practice have enabled them to contend with difficulties in every shape. As these cases contain important practical precepts, they are furnished in full, in order that nothing of the details of the extirpation of tumors in this region may be overlooked.

§ 1.—Removal of Large Adenoma Lymphatic Glands of the Neck.

Operation of Mott, of New York.*—A little boy, five years old, had a tumor on the neck, which had resisted every plan of treatment. It occupied the entire side of the neck, reaching from above and behind the ear to below the clavicle, going underneath and also lapping this bone. In front, it passed beyond the central line of the larynx and trachea, crowding these parts to the opposite side; and behind, it passed under the trapezius muscle, so as to turn the head also toward the opposite side. In appearance, the tumor was irregular and lobulated, while to the touch it was firm and without fluctuation at any point, Plate XXXIV. Fig. 2.

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* Transact. New York Acad. of Med., vol. i. part i. p. 90. New York, 1851.

The patient being placed entirely under the influence of chloroform, the operation was commenced.

Operation.—In order to command the whole tumor, a crucial incision was made in the integuments, the first cut extending from behind the ear to the clavicle, and the second a little obliquely to this, from the anterior to the posterior edges of the tumor, so as to traverse the longest axis of the whole mass. These incisions being carefully conducted through the skin, platysma-myodes and under layer of the superficial fascia, so as fairly to denude the tumor, the dissection of the lower flap was first commenced, the veins and arteries being tied as they were divided. In dissecting off this flap, the mastoid muscle was found to be so incorporated with the tumor as to make it necessary to divide the muscle about two inches from the sternum and clavicle. This division exposed the lower portion of the tumor, and showed the internal jugular vein running through its substance. On the inner side of the mass, the common carotid artery could be dissected bare for several inches; but the vein was so imbedded in the tumor that it was totally impracticable to save it. Being therefore seized with a pair of forceps, it was divided, and a ligature instantly placed beneath the forceps, the upper end being held by the fingers of an assistant, while the dissection was continued. The tumor, being thus separated from the vein, was found to have destroyed by its pressure the sterno-hyoid and sterno-thyroid muscles, and was now detached from the upper and inner edge of the clavicle as far as the anterior edge of the trapezius muscle. Getting under the mass in this way, the tumor could be more readily and safely detached from the parts below, and, on dissecting it from over the scalenus anticus, careful attention was given to the phrenic nerve. The posterior and upper part being then dissected from over the mastoid process and turned down, a portion of the diseased structure was seen to pass beneath the muscle, and to be so incorporated with it as to require the division of the muscle at this point, the middle third of it being left attached to the tumor.

The anterior and upper part being now separated from the side of the pharynx and larynx, it was found, after dissecting the tumor from the common carotid artery opposite the thyroid and cricoid cartilages, that the deep jugular vein could not be safely detached. A second ligature was therefore applied to this vein, about an inch below the angle of the lower jaw, and the vessel divided below it, leaving several inches of the vein in the tumor, after which the whole mass readily came away. More than twenty ligatures were applied to different arteries and veins, and the effects of the chloroform being allowed to pass off, the wound was closed by stitches, adhesive strips, lint, and a bandage. When the parts had sufficiently healed, care was also taken, by resorting to bandages and position, to prevent the head becoming awry, and the patient recovered without inconvenience, notwithstanding the loss of the middle third of the mastoid muscle.

§ 2.—Extirpation of a Large Malignant Tumor of the Neck.

Operation of John C. Warren, of Boston.*—In this case the tumor had existed over a year; occupied the whole of the left side of the neck from the ear to the clavicle, and from the trachea to the spine; the mastoid muscle, and all the arteries, veins, and nerves of the neck being presumed to be included in its substance, while a process extended under the jaw into the pharynx, and filled the left half of this cavity with a red tumor which greatly impeded deglutition, the whole structure being very hard, knotted, uncolored, and insensible.

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* Warren on Tumors, p. 175.

Operation.—In commencing the operation, the patient being of course fully etherized, an incision was made from behind the ear to the anterior third of the clavicle, the surface of the tumor uncovered, and the mastoid muscle sought for, but found to be partly absorbed and partly buried in the tumor. After clearing the latter from the ear, the jaw, larynx, and dorsal muscles, an attempt was made to get under the tumor just above the clavicle, and then the difficulties of the operation appeared, the carotid artery, internal jugular vein, and par vagum nerve being covered by it and connected with processes of the mass in such a manner as to render it difficult to distinguish them. This being at last accomplished by breaking down the lower part of the tumor, the vein was found to be obliterated, and the artery diminished in size, but pervious. A ligature being then applied on the latter, the par vagum nerve was separated as carefully as possible, though not wholly cleared of the tumor, and the separation of the latter from the nerves at the upper part of the neck attempted and successfully accomplished, with the exception of the sublingual nerve, which so barred the access to the pharyngeal part of the tumor that it was determined to divide it. This being done, the operation was finished by breaking down such parts of the tumor as could not be separated from the other nerves, when the parts were brought together, and the patient put to bed, there being but little hemorrhage, a fact stated by Warren as common in large and hard tumors. The patient at first did well after the operation, but died about a year subsequently, of an ulceration of the throat, which created a difficulty in swallowing.

A yet more complicated and severe operation was performed in another case by Warren.* In this patient, the tumor extended from the spinous processes of the cervical vertebræ to the lower jaw, pharynx, œsophagus, and larynx, running upward behind the ear, and downward to near the clavicle. This tumor, which had existed for thirty years, had turned the face to the opposite side, impeded the motions of the head and neck, and caused dizziness, headache, and dyspnœa. After examining and considering the case, Warren was induced to think that the tumor had originated in the lymphatic glands behind the posterior edge of the sterno-cleido-mastoid muscle; had extended backward under the trapezius to the spine, and forward under the mastoid muscle to the pharynx; that it adhered to the splenius, complexus, and trachelo-mastoideus muscles, and also involved the digastricus, as well as all the styloid muscles; that the external carotid artery, with all its branches, excepting possibly the superior thyroid, were involved; and that the jugular and smaller veins, together with the three or four superior cervical nerves, the par vagum, sublingual and its descending branch, the glosso-pharyngeal, laryngeal, and great sympathetic were also connected with it.

After a full consultation and statement to the patient of the dangers of the operation, and the impracticability of disengaging the whole tumor, the propriety of submitting to it was left to the patient's decision, and he deciding to do so, the operation was performed at Lincoln, near Boston.

Operation.—"The patient being seated in a chair with his head supported, an incision was made from the spine to the angle of the jaw, to meet another incision which was carried from this point downward to near the clavicle, in the direction of the anterior edge of the sterno-cleido-mastoid muscle. This flap of integuments being turned down after a laborious dissection, in consequence of its close adhesion to the tumor, the posterior half of the latter was exposed from the spine to near the trachea, showing the mastoid muscle firmly imbedded in the scirrhous mass. Having dissected the muscle from its inferior adhesions, the carotid artery was exposed and tied. The superior flap of the integuments being then raised, an attempt was made to disengage the mastoid muscle from the furrow it occupied in the upper portion of the tumor, in order to pursue the dissection beneath it; but this being found impossible, it remained either to divide the muscle and the accessory nerve, or to divide the tumor through its middle behind the muscle. The latter course being chosen, the mass was cloven in two, the posterior half dissected out, and the anterior then disengaged by great care from the posterior face of the sterno-mastoid and digastric muscles, as well as from the nerves, bones, parotid, and submaxillary glands; but some portions remained adherent to the fore part of the bodies of the vertebræ and to their transverse processes, and could not be wholly dissected without exhausting the patient's strength. The actual cautery was therefore applied to them without causing much complaint.

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* Warren on Tumors, p. 177.

"In the latter part of the operation, the patient was occasionally seized with a spasmodic cough produced apparently by the division of some of the branches of the accessory nerve. The internal jugular vein, being buried in the tumor, was compressed between it and the clavicle and then divided and tied, a few bubbles of air which entered the open mouth of the vessel being arrested and forced back again by a finger applied below the opening. The principal branches of the first and second cervical nerves were now seen and divided, and others in the substance of the tumor were also divided, as indicated by the patient's sensations, although they were not seen.

"The integuments being then laid down on the face of the wound, and moderately secured so as to protect it, without too much confining the parts destroyed by the cautery,"* the operation was completed, and the patient is believed to have recovered.

Operations of a similar character by Rodgers and Stevens, of New York; Hayward, of Boston; Gibson, of Philadelphia; Spencer, of Virginia; and Smith, of Baltimore, will be found referred to in the Bibliographical Index at the end of this part.

Remarks.—From the details furnished in the preceding accounts of the removal of a most dangerous class of tumors of the neck, a good idea can be obtained of the anatomical as well as operative skill requisite for their execution. In fact, no surgical operations require a nicer discrimination of structure than those connected with the removal of tumors in this region, muscles, nerves, arteries, and veins being all liable to be displaced and changed in character to a greater or less extent, yet all requiring to be accurately recognized at each step of the dissection. But though an operation for the removal of large tumors is important and highly dangerous, it does not really deserve as much consideration and caution as those in which the disease is less developed. In a case of the magnitude of those above cited, danger is so evident that prudence and forethought are ready to contend with it, the presence of skillful assistants, together with all the adjuvants likely to prove serviceable, being naturally prepared by the operator.

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* Warren on Tumors, p. 182.

The truly dangerous cases, in my estimation, are the small and apparently inconsiderable tumors of the neck, the removal of which seems to be so simple and easy that they might almost be designated as traps to catch the inexperienced and fool-hardy, or those in whom boldness takes the place of discretion. The young surgeon cannot, therefore, be too much upon his guard when consulted in reference to small tumors of the neck. In these cases, when he has decided to attempt their removal, let him always think that, before his operation is completed, he may be compelled to open the sheath of the vessels and ligate the carotid artery, and, with such a prospect before him, his operations will not only be well performed, but acquire a simplicity of character that will be mainly due to his thorough preparation for all the contingencies that may arise, in consequence of the difficulty of settling a question that can only be decided by his operation, to wit, the attachments of a tumor in the neck.

SECTION III.

BRONCHOCELE, OR GOITRE.

In the preceding section, the account of the operative proceedings requisite for extirpating tumors of the neck has been limited to such as are sanctioned by the highest authorities, and therefore presumed to be fit cases for such operations. There remain, however, a class, yet to be described, the propriety of removing which is extremely doubtful, and seldom now thought of, except in cases where the patient's sufferings from suffocation are most urgent.

§ 1.—Bronchocele, or Goitre.

Pathology.—Bronchocele—βρονχος, trachea, and κηλη, a tumor—is a well-known disease, which consists in the enlargement of either one or both lobes of the thyroid gland, though the same name has been occasionally applied to a degeneration of the surrounding cellular structure and lymphatic glands. According to Warren,* "the thyroid gland is subject to two kinds of enlargement: one of a temporary nature, known as goitre; the other, a permanent scirrhus."

True goitre exists at all periods of life, especially in the female sex, and consists in a chronic inflammation of the thyroid gland itself, which, beginning at some one point, is apt to extend until, as in a case related by Alibert, it reaches to the thighs of the patient. The changes within a goitre vary with its development; presenting sometimes a soft gelatinous matter, or a more hardened structure interspersed with cysts containing a serous, glairy, or melicerous substance, and occasionally pus, fibrin, calcareous concretion, or pure blood.† Vascular derangement being here very evident, the thyroid arteries are commonly found to be much enlarged. In some cases the swelling seems to consist almost entirely of a congeries of varicose veins, and, under these circumstances, there may be considerable sanguineous effusions, the blood being poured into the enlarged vesicles, or into the connecting cellular substance of the gland.‡ Besides the hypertrophy of the parts, consequent on chronic inflammation of this gland, the thyroid body is also sometimes the subject of scrofulous, lymphatic, or schirrous degeneration.

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* Warren on Tumors, p. 302.

† Pathological Anatomy, by Samuel D. Gross, p. 407. ‡ Opus citat.

In the **Scrofulous Goitre,** the areolar tissue enveloping the gland and prolonged throughout its structure is thick, compact, and resisting, so that each portion is transformed, as it were, into a cyst which is filled with a matter of varied color and consistence, though all the elements of the gland may yet be recognized.

In the **Lymphatic Goitre,** certain fluctuating points are readily recognized, the cysts being found to contain serous, albuminous, lactescent, or puriform matter; or the points, which appear to fluctuate, consist of a spongy structure analogous to that of the placenta.*

The **Scirrhous Goitre** presents a tumor covered by a firm fibrous capsule, and consists of a spongy texture, in which appears a considerable number of cells, some of which are of large size, and contain a bloody fluid. Its consistence is often firm, but not scirrhous, except at the upper part, which sometimes has the texture, consistence, and white color of true scirrhus.†

Diagnosis.—The **Goitrous Tumor** has a smooth surface, a somewhat elastic feel, follows all the motions of the larynx, especially in swallowing, and gives no sensation of crepitation, fluctuation, or pulsation.

Cysts of the thyroid region, unless enormously distended or multilocular, give the sensation of fluctuation. Tumors similar to these have been described by Maunoir as "Hydrocele of the Neck."

Scrofulous enlargement about the thyroid gland tends to suppuration, and the patient shows the marks of a scrofulous diathesis.

In **Scirrhus,** the tumor grows very slowly, and is small, its surface is hard, lobulated, or tuberculate; it is accompanied by pain, and is liable to ulceration. In **Fungoid** degeneration, there is the ordinary constitutional disturbance of the complaint as seen elsewhere.

Owing to the position of the thyroid gland, it has occasionally happened that its proximity to the carotid artery has led the observer to regard it as an aneurism, a case of which has been published by Griffiths, of Philadelphia.‡ In this case, dissection alone revealed the disease. As a general rule, however, the pulsations of an aneurism give a motion to the whole tumor; and Boyer has facilitated the diagnosis of one from the other, by directing the relaxation of the muscles by inclining the head to one side, by which means the impulse will be checked, if it is a goitrous tumor.§

The propriety of operating on these tumors is a point on which most surgeons are very decided, the opinion being almost universal that any attempt to extirpate them is most hazardous. It is presumed, therefore, that any surgeon who may be called on to treat a case, will first resort to every remedial measure, and especially to the use of iodine internally and externally, for many months, before entertaining for a moment such an idea. To those who desire more detailed information of the pathology of this disease than is to be found in most of the general works which treat of this tumor, I would recommend the articles in the volumes hereafter quoted, an extended article by Gibson,‖ of Philadelphia, and the memoir of Benjamin Smith Barton, of Philadelphia, published in 1800.

Although the extirpation of a goitre cannot be regarded as a justifiable operation in most instances, the distress of breathing and swallowing which it sometimes causes may render it imperative on the surgeon to attempt some means of affording relief; but even then local depletion, iodine, and similar means should be first fully tried before resorting to so dangerous an operation.

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* Dict. de Med., tome xiv. p. 172.

† Warren on Tumors, p. 307.

‡ Eclectic Repertory, vol. ix. p. 120.

§ Dict. de Med., tome xiv. p. 177.

‖ Phila. Journal Medical and Physical Sciences, vol. i. p. 44, 1820.

Treatment of Goitre.—In a tumor which has presented such varied pathological changes as those seen in this gland, and in which many points have not been described with the accuracy that might be desired, it is not surprising that various plans of treatment should have been recommended, in addition to the general remedial measures just spoken of, surgeons having at different periods advised the use of a seton, or of caustic, as well as the ligation of the whole tumor, or the placing of a ligature upon the thyroid arteries, or compression or extirpation. That some of these means are better adapted to the mere cystic tumors of this region than to the cure of a true goitre, cannot be doubted, and such suggestions can therefore be regarded only as indicating the different views, in relation to the condition of the diseased part, held by those who have suggested them. Any operation upon a true goitre being usually deemed inadmissible, except as a last resort, I shall only refer to such means as have been employed in the United States, and of these the operation of compression will be first mentioned, as being that which may be most readily and safely tried.

Treatment of Goitre by Compression.—*Operation of Dwight, of New York.**—After preparing "three strips of good glazed brown cambric, spread with emp. ol. lini cum plumb. sem. vit. oxid.—diachylon—each of half the width of the tumor, and of a length sufficient to reach from the lower edge of the scapula of one side obliquely up the opposite side of the neck and across the lower part of the tumor, and passing thence around the neck and across the shoulder, down to the lower edge of the opposite scapula, he warms and applies them to the part in the line mentioned, so that each strap may cross behind the neck like suspenders. The first strap being drawn quite tightly produces very considerable turgescence of the blood-vessels of the face, and causes the patient to shrug his shoulders for a few minutes, until the thyroid vessels become sufficiently compressed to enable him to breathe more comfortably, when the countenance usually resumes its natural appearance, as is often the case in less than five minutes. The second strap being then passed in the same manner across the upper part of the tumor, or from half an inch to an inch from the first, according to the size of the tumor or length of the neck; this strap should also be drawn as tightly as the first, and the same time allowed for the change in the countenance, when, the third strap being applied over the intermediate space, the operation is completed.

"Ordinarily, these plasters adhere to the part for ten days or a fortnight, if the weather is cool, and, on becoming loose, ought to be removed, when, if the pressure has been well applied, the tumor will be found to have become slightly less, and the skin somewhat reddened and tender. When this is seen, it will be better to wait till the integuments assume their natural appearance, when the application may be renewed.

"The first application of these straps has in one case been sufficient to effect the cure, but the average repetition of them has been as high as four times in each case. When the bronchocele becomes diminished to half its size at the time of the first application, the tumor will continue to disappear without further care; there having been no failure in twenty cases from this mode of treatment. The iodine had not succeeded in several instances. In two patients, the disease returned at the end of two years, but disappeared on a new application of the straps."†

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* Transact. Am. Med. Association, vol. iv. p. 248, 1851.

† Buffalo Medical Journal, Jan., 1851.

Ligation of one of the Thyroid Arteries.—*Operation of Jameson, of Baltimore.*—An incision, about an inch long, being made parallel with the trachea, and about midway between it and the inner edge of the sterno-mastoid muscle, and, having reached the thyroid artery by a very cautious dissection, so as to avoid dividing any considerable branch of the nerves, an animal ligature was applied to the vessel, and the wound allowed to heal over the ligature. Several months subsequently, the tumor, by actual measurement, was considerably less.

The ligature of all the thyroid arteries would only be a repetition of this operation, but would certainly increase the patient's danger, and require a perfect anatomical knowledge of the structures concerned Four cases of cure from the use of the ligature have been recorded by European surgeons.

Subcutaneous Ligation of Goitre.—*Operation of Ballard and Rigal de Gaillac.**—"The goitre, being very large, was tied in three portions, each being strangled by a separate thread, as follows: Two long waxed ligatures, each armed with three needles, viz., one, *straight and cutting*, being applied at one end of the thread; the second, *round and pointed*, in the middle of the thread, to be drawn double across the tumor; and the third, armed at the other end of the thread with a *curved* needle, were each properly arranged. Then a vertical fold of the skin, being raised opposite the superior part of the tumor, was traversed by the straight needle at one end of the thread, and, the fold being let go, the ligature was made to describe a curve round the upper part of the tumor, so that an end hung out on each side of the goitre. Through the same punctures, but beneath the tumor, the round and pointed needle was then passed and directed from one side to the other, so as to draw with it the middle of the ligature, which, when passed, was removed by cutting across the loop, so that there was now a complete loop surrounding the superior third of the tumor at its base, with its two ends hanging out of one puncture, while the other thread or that passed across and beneath the upper third, was destined for its middle portion. The second and third ligatures being then passed in like manner, it was only requisite to form round the middle third a complete and subcutaneous loop, which was effected by using the remaining curved needle, when all were tightened by a serre nœud."

Febrile reaction followed, and on the fifth day a puncture with a lancet was necessary to give exit to a little pus and gas which had accumulated under the skin; but the patient was subsequently cured, with only a slight trace of the affection.

Dissection of the Skin and Ligation of the Tumor.—*Operation of Mayor.*—The tumor being exposed by a double elliptical incision, which turned back the skin to the right and left, the base of the tumor was traversed by two ligatures, the two ends of the same ligature being tied so as to strangulate separately each half of the tumor.

A somewhat similar operation has been successfully performed by Liston, of London, and is represented in Plate XXXVII. Fig. 1.

Extirpation of a Scirrhous Thyroid Gland, by J. C. Warren, of Boston.†—The patient being in the upright position, an incision nearly four inches long was carried along the anterior edge of the sterno-mastoid muscle, so as to expose the platysma-myodes, which was incised so as to present the edge of the sterno-mastoid. On turning this aside, the sterno-hyoid and thyroid muscles were perceived to cover the tumor in such a way that it was necessary to separate them and dissect between them. The surface of the tumor, being then brought into view, was fully exposed by dissection, and separated from the sheath of the carotid artery by the handle of the knife. This apparently loosened its attachments, but a solid adhesion being found to the trachea for one or two inches, and also to the œsophagus for a small extent, which required the use of the knife, the dissection was pursued upward and backward, in order to extract the superior corner of the gland. The superior thyroid artery being divided in so deep a position as to prevent its ligation between the muscles, the common carotid was therefore tied. The inferior thyroid did not bleed, or was supposed not to exist, and the patient, after serious symptoms, recovered in about one month.

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* Malgaigne, Philadelphia edit., p. 378.

† Warren on Tumors, p. 305.

Remarks.—Of the different operations just detailed, compression is certainly the safest, and, judging from the accounts furnished, the most successful. Ligation of the thyroid arteries, although successful in a few cases, is so hazardous and difficult an operation that few will probably be disposed to attempt it; in addition to which, there would certainly be good reason to fear a return of the circulation through the numerous anastomosing branches. As the ligatures must also be placed near the origin of the thyroid arteries, there has not always been a sufficient amount of the vessel left to prevent secondary hemorrhage, a case being on record, where, from the proximity of the carotids, the loss of blood has been most alarming, nothing but compression by the fingers of assistants, during eight consecutive days, having rescued the patient.

Although I have placed among the preceding operations an account of the extirpation of the thyroid gland as performed by Warren, it has been done rather to complete the record than from a wish to lead any one to its repetition, even when sanctioned by such excellent authority. Though occasionally performed, an attempt to extirpate a goitrous tumor is so liable to cause immediate death from hemorrhage, that few, as before stated, deem the operation justifiable, more than one patient having died on the table. The ligature, both by the subcutaneous method and also after the exposure of the tumor, has succeeded; yet the obstruction of the circulation through the part by this method has also been followed by alarming symptoms of suffocation and congestion of the brain. Every surgeon, therefore, should avoid operating on any case of true goitre, unless fully prepared to encounter great difficulties, or with the view of relieving *certain* suffocation. In the operative treatment of this tumor, it may well be said that "discretion is the better part of valor."

SECTION IV.

HYDROCELE OF THE NECK.

Pathology.—The term **Hydrocele**—*υδωρ*, water, and *κηλη*, tumor—though generally limited to collections of fluid within the tunica vaginalis testis, has also been applied by Maunoir, of Geneva, to those **Encysted Tumors** which are filled with liquid, and found in that portion of the neck which is near the thyroid gland. These tumors are met with, at various periods of life, in both sexes; their progress is slow, and they often arise, without any appreciable cause, from the cellular spaces of the thyroid gland, being occasionally congenital. Though seldom larger than a walnut, they may acquire the size of an orange, and impede respiration and deglutition. Their contents vary from a thin serum or oily liquid to a thicker consistence, the cyst itself varying in thickness from the fourth of a line to a quarter of an inch or more. The skin covering the tumor seldom undergoes any change except when attenuated by the size of the tumor, when the subcutaneous veins may become apparent. The tumor is free from pain or tenderness on pressure, fluctuates slightly, and, if seated over an artery, might be mistaken for an aneurism, or, if over the thyroid gland, be supposed to be a goitre.*

Operation.—These cysts may be treated on the same principles with those seen elsewhere, that is, evacuated by a simple puncture, or with a trocar, or cured by exciting inflammation within the cyst itself by means of a seton, or by acupuncturation, or by injecting iodine, or wine and water, or a solution of sulphate of zinc, or by excising the cyst, or by incision and tents, as proposed by Porta, of Padua.

The selection of any of these plans of treatment will depend somewhat on the patient's constitution and circumstances. The use of the seton has led to such irritation as to induce death. Erysipelas is apt to follow the injection of iodine or other stimulating liquids, and the excision of the cyst, like any operation upon an enlarged thyroid gland, exposes the patient to the risks of severe hemorrhage if the proper structure of the gland is invaded. All these plans of treatment have, however, sometimes succeeded, and, when the surgeon is aware of the risk attending them, under certain circumstances, the selection of either plan may justly be left to the decision of the moment.

From the resemblance of these tumors to those seen in other regions, they are generally regarded as belonging to the encysted class; and the application to them of the term "Hydrocele of the Neck" is, therefore, liable to lead to error. In the opinion of Percy, those found over the thyroid gland were simply "softened bronchocele." I have seen these tumors twice in this position, and once over the parotid gland, in both of which they were nearly of the size of an orange. The fluctuation being evident, puncture and the introduction of a seton accomplished the cure.

CHAPTER VIII.

THE LIGATION OF THE ARTERIES OF THE NECK.

SECTION I.

ANATOMY OF THE BLOOD-VESSELS OF THE NECK.

THE great points of reference in ligating the arteries of any portion of the body are the course of the muscles of the part, after which the operator may seek for the adjacent bony prominences, or be guided by the position of the nerves of the region. In the arteries of the neck, such points may be readily found, and a brief reference to the normal anatomical relations of each of them will, therefore, prove sufficient as the general guides for these vessels.

The **Common Carotid Artery,** arising from the innominata on the right side about the level of the top of the sternum, and from the arch of the aorta on the left about one inch and a quarter below the top of this bone, ascends the neck on the outer side of the trachea and larynx, as far as the inferior cornu of the os hyoides in the male, though a little lower in the female. In the lower part of the neck, the right artery inclines more outwardly than the left, the latter ascending almost vertically.

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* Liston's Surgery, by S. D. Gross, M.D., Louisville, p. 386.

In this course, each artery, together with the internal jugular vein and par vagum nerve of each side, is inclosed in a firm sheath, which is connected with the fascia of the neck, the vein being on the external side of the artery, and swelling in front and above it, while the nerve is situated between the two vessels or a little behind them.

Directly above the sternum and clavicle, the vessels and nerve, arranged as just described, are covered by the sterno-hyoid and thyroid muscles, as well as by the sternal origin of the sterno-cleido-mastoid. On a line with the lower part of the thyroid cartilage, the artery is crossed obliquely by a ribbon-like muscle, the omo-hyoid. Behind the vessels and outside of their sheath may be felt the transverse processes of the cervical vertebræ, covered by the longus colli muscles, and upon these muscles, but exteriorly to the course of the vessels, as well as behind them, is the great sympathetic nerve. Alongside of the larynx, the carotid artery is very superficial, being covered only by the skin, superficial fascia, and platysma-myodes, though it is here also crossed by the omo-hyoid muscle. Having reached the space between the os hyoides and the larynx, the common carotid divides into the internal and external carotids, the latter being generally the smallest in children. No branches come off from the common carotid in the normal condition of the parts, though occasionally the inferior thyroid or the inferior pharyngeal arteries may be in the way of any incisions upon the main trunk, at the upper part of the neck.

The **Internal Carotid** in the adult is smaller than the external, and extends from the level of the larynx to the brain, being between the external carotid and the vertebræ of the neck, in front of the internal jugular vein, and having the par vagum nerve at its external margin. Near the base of the lower jaw, it is crossed externally by the digastric and stylo-hyoid muscles, and is immediately afterward concealed by the ramus of the jaw.*

The **External Carotid** extends from the termination of the primitive carotid to the neck of the lower jaw. In the early part of its course, it is in front of the internal carotid and between the pharynx and sterno-mastoid muscle, where it is only covered by the skin, superficial fascia, platysma-myodes, and its own sheath. Just above this, it is crossed internally by the hypoglossal nerve, which sends off the descendens noni branch, the latter nerve being found upon the sheath as far as below the omo-hyoid muscle. Somewhat above this nerve, the artery is crossed by the digastric and stylo-hyoid muscles, and lies on the superior constrictor muscle of the pharynx near the tonsil gland. About its middle, it is crossed internally by the stylo-glossus and stylo-pharyngeus muscle, and then ascends through the substance of the parotid gland to the neck of the jaw, where it gives off the internal maxillary and temporal arteries.

The **Superior Thyroid Artery** arises from the external carotid, about a line from its root, and the **Lingual** comes off about six to twelve lines above this.† The anastomosis between the arteries of the two sides, through all their branches, is also exceedingly free.

The course of the artery, from its origin to the level of the os hyoides, may be designated by a line drawn from the mastoid process to the inner edge of the clavicle, or by the course of the sterno-mastoid muscle, when it can be recognized.

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* Horner's Anatomy. † Ibid., vol. ii. p. 207.

SECTION II.

RULES TO BE OBSERVED IN THE LIGATION OF ALL ARTERIES.

The accumulated experience of the profession in the application of the ligature to an artery having established certain general rules as essential to the proper performance of the operation—although some few surgeons have modified them, or substituted others to meet particular difficulties—it will be found useful to follow them in the application of every ligature. As the object to be attained in ligating a vessel is a direct change in the course of the normal circulation, these rules may be condensed into two general ones, and on these all surgeons, it is believed, agree, to wit: 1st, always to expose the vessel without opening it; and 2d, to ligate it with as little disturbance as possible to the surrounding parts. These general principles have been carried out in various ways; but as the views of Lisfranc, in relation to the details, are not only the soundest, but have also been tested by personal experience, I shall adopt them as those most likely to prove useful to the young operator.

In ligating any artery, Lisfranc advises the surgeon—

1st. To expose the vessel without opening it; and in order that he may do so, suggests the following method of proceeding:—

a. To make sure of the position of the vessel.

Special anatomy, as usually taught, presents every medical man with accurate information in regard to the ordinary position of the arteries; but as these vessels are liable to various anomalies and to irregular distribution as well as to the changes consequent upon disease, special attention should be given to the position of the vessel upon each patient at the time of the operation.

b. To find the artery.

In seeking the vessel, notice should be first taken of the position of such muscles as usually indicate the course of the artery, or of those which have been termed "muscles of reference," so that by causing these muscles to contract and become prominent, the surgeon may readily recognize any deviation of the artery from its natural relations with these parts; or he may feel for the pulsation of the artery; or, if the tissues are too much thickened, or the vessel lies too deep to admit of this, lines may be drawn from such fixed points of the skeleton as normal anatomy teaches us will cross or follow the usual course of the artery.

2d. To ligate the artery with as little disturbance as possible to the surrounding tissues.

After recognizing the position of the vessel, its exposure becomes the next point for consideration, and, in order to prevent any variation from the proper line of incision, as well as to steady the skin, Lisfranc advises the operator to bring the four fingers of his left hand to the same level, and then, placing them perpendicularly on the skin, to be careful not to draw the latter to one side, while he incises the integuments by drawing the scalpel close along the edges of the nails. Malgaigne, however, objects to this direction as being likely to displace the integuments over the vessel, though my own experience is favorable to it.

When the artery is superficial, the incision through the integuments should be parallel to its course; but when it is deep seated, an oblique incision, by affording a greater line for any variation, will add much to the facility with which the vessel may be found. When the aponeurosis of the part is directly in contact with the sheath of the vessels, it is generally safer to open the sheath on one side and then slit it up upon a director. On reaching the sheath of an artery, or the artery itself, the vessel may generally be told by its yellow or dull-white color, by its pulsation, and by its becoming flattened and collapsed when the circulation is interrupted between it and the heart.

In order to isolate the artery with as little disturbance as possible of surrounding parts, the relative position of the adjacent veins and nerves should be recollected, and the adhesions of the sheath and other tissues only loosened sufficiently to permit the passage of the ligature. To do this, it is important that a good aneurismal needle be selected, that is, one which is neither so sharp as to expose the vessels to perforation, nor so thick and dull as to render it difficult to pass its point through the cellular tissue of the part. When, in passing the needle around the vessel, the point appears beneath any dense cellular structure, the latter should be supported by the pressure of a finger in order to facilitate its perforation by the instrument.

Another rule, which is an excellent one, and which Malgaigne* has designated as "the rule of the guiding points," is the following:—

"Do not, at the commencement of the operation, occupy yourself with looking for the artery, but seek the first marked point of reference, then the second, then the third, if there be one, and so on to the vessel."

Mott, of New York, whose experience in ligating the large arteries has probably been greater than that of any other surgeon in the United States, advises† that in every operation upon these vessels but little use should be made of the scalpel after the edge of the muscle of reference is laid bare, the fingers, director, or handle of the knife being capable of separating these parts quite as readily as its edge, without at the same time exposing the surgeon to the troublesome oozing which is apt to ensue on the division of the minute vessels. By pursuing this plan, the main artery can also be more distinctly seen.

Parrish, of Philadelphia, in connection with Joseph Hartshorne and Thomas Hewson, also of Philadelphia, was accustomed to employ a knife which was rounded at the end, Plate XXXV. Fig. 1, for the purpose of dissecting about the sheath of the vessel.‡

In order to hold the parts asunder, Mott employs curved spatulæ, Plate II. Fig. 10, and divides the sheath of the vessels perpendicularly, and only upon the front of the artery, never dissecting or using the blade on the sides of the vessel, but introducing the knife-handle, and separating the structure on each side, so as to denude the artery only to such an extent as will permit the aneurismal needle to pass. He has generally employed the Philadelphia needle,—Parrish, Hewson, and Hartshorne, Plate XXXV. Fig. 2,—and always introduces it so that its point will pass from the vein, and not to it.

This needle having been employed by Mott, has been very incorrectly credited to him—it being, as is well known, by the publication of Parrish in the Eclectic Repertory, in 1813, the "Philadelphia needle."

In attempting the cure of aneurisms by the application of the ligature, surgeons now generally resort to the method of Hunter, in which the ligature is applied to the sound coats of the vessel at some little distance above or on the cardiac side of the tumor, that of Brasdor, in which it was ligated on the distal side of the tumor, being seldom employed. The latter opera-

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* Operat. Surg., Philad. edit. p. 140.

† Mott's Velpeau, vol. i. p. 301.

‡ Eclectic Repertory, vol. iii. p. 229, 1813.

PLATE XXXV.

INSTRUMENTS EMPLOYED IN THE LIGATION OF ARTERIES; WRY-NECK; ŒDEMA OF THE GLOTTIS, AND HERNIA.

Fig. 1. Parrish's knife for dissecting about the sheath of arteries. *Rorer's pattern.*

Fig. 2. The Philadelphia Aneurism needle, employed by Parrish, Hewson, and Hartshorne. *Rorer's pattern.*

Fig. 3. Another form of this needle. Each needle has two eyes, and the ligature is passed through the one nearest the handle. *Rorer's pattern.*

Fig. 4. Another needle, very much curved. "   "

Fig. 5. Blunt points, adapted to a common shaft, and intended to be detached in order to pass the ligature around the artery. *Rorer's pattern.*

Fig. 6. Sharp points, intended to be similarly attached and detached. *Rorer's pattern.*

Figs. 7, 8. Needles of other curves and lengths, adapted to deep arteries in confined points. *Rorer's pattern.*

Fig. 9. A hook to be inserted into the eyes near the points of Figs. 5 and 6, when unscrewed from the shaft, in order to draw them around the vessel. *Rorer's pattern.*

Figs. 10, 10. Knot-tiers, to tighten deep-seated ligatures. "   "

NOTE.—The above set comprises the instruments included in the operating case of the late Jos. Parrish, now in my possession, and is the same as that often designated as "Mott's American needle." Its value as an instrument renders it proper that the invention should be correctly credited. The full account of the investigations of Parrish, Hewson, and Hartshorne may be seen in the *Eclectic Repertory*, vol. iii. p. 229, 1813.

Fig. 11. Horner's aneurism needle. *Kolbè's pattern.*

Fig. 12. Gibson's aneurism needle. A watch-spring is passed beneath the vessel, and the ligature being attached is thus drawn round it. *Kolbè's pattern.*

Fig. 13. Tenotome or knife adapted to the section of the sterno-cleido-mastoid muscle. *Kolbè's pattern.*

Fig. 14. Apparatus to bring the head into position in cases of wry-neck, especially after the division of the muscle. *Kolbè's pattern.*

Fig. 15. Gurdon Buck's knife for scarifying the glottis in cases of œdema. *After Buck.*

Fig. 16. Curved scissors for the same object. "   "

Fig. 17. Enterotome of Dupuytren. *Charriere's pattern.*

Fig. 18. Blandin's Enterotome. "   "

Fig. 19. Cooper's Hernia bistoury. *Kolbè's pattern.*

Fig. 20. Small blunt-pointed Hernia bistoury. "   "

Fig. 21. Straight-pointed Hernia bistoury. "   "

Plate 35.

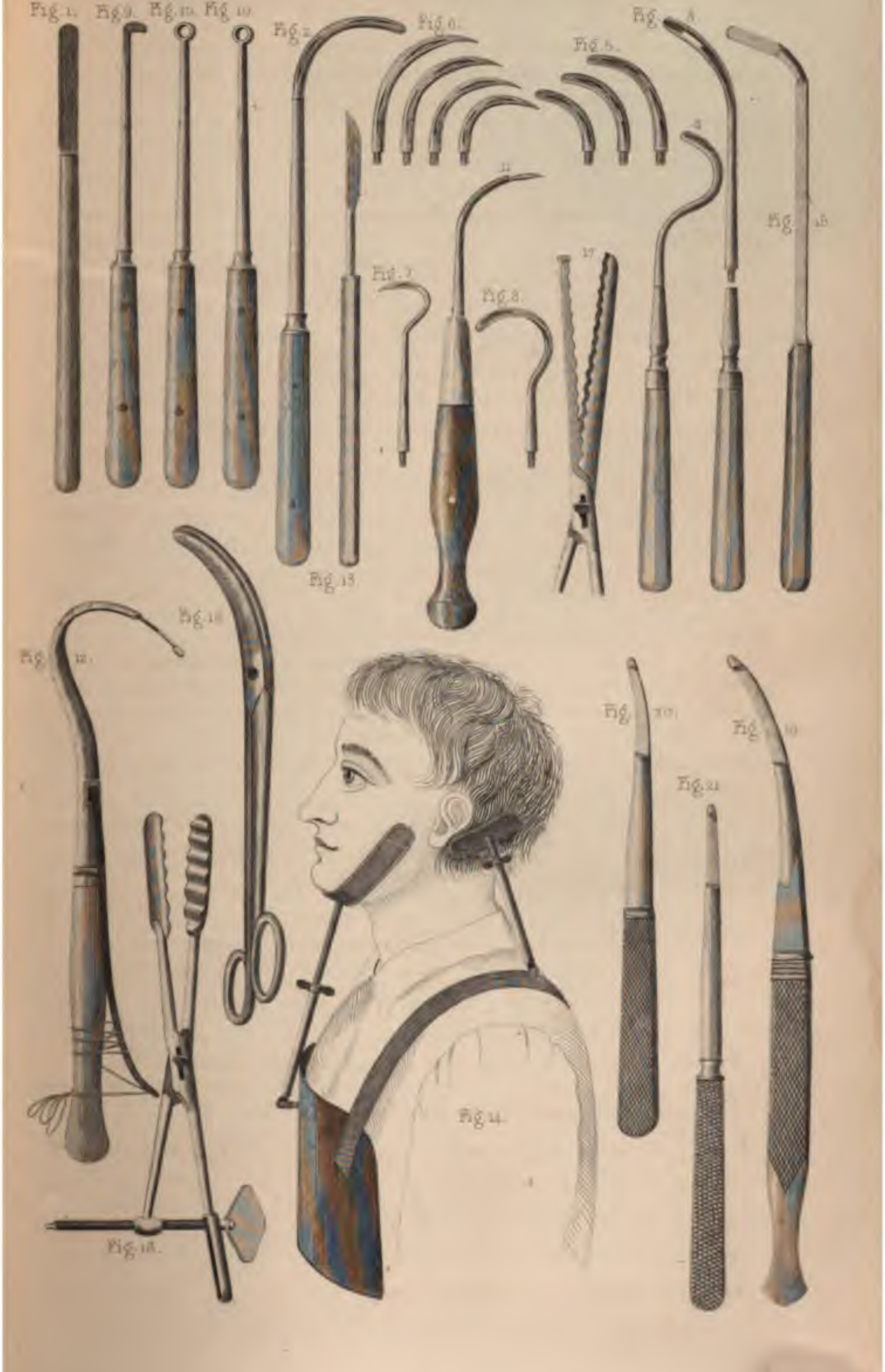

Fig. 1.
Fig. 9.
Fig. 10.
Fig. 10.
Fig. 2.
Fig. 6.
Fig. 5.
Fig. 4.
3
11
Fig. 15
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Fig. 7
Fig. 8
Fig. 13
Fig. 16
Fig. 12.
Fig. 20.
Fig. 19
Fig. 21
Fig. 14.
Fig. 18.

tion is also applicable only to cases in which no branch comes off from the artery between the ligature and the sac, as is often the case, or in those where there is no branch communicating with the sac itself, which is also often met with. It is, however, especially applicable to aneurisms so seated as not to leave sufficient space between the tumor and the main trunk of the artery for the application of the Hunterian plan, as in an aneurism at or near the innominata, or at the root of the right subclavian; in these cases, Brasdor's operation is very useful. In other cases, and they are by far the most numerous, the application of the ligature can be most advantageously made by the plan proposed by Hunter, that is, its application on the sound artery between the tumor and the heart. This operation is, therefore, that which will be hereafter followed in the description given of the treatment of aneurisms by the ligature, except in the cases above mentioned of their development at the root of the subclavian, or in the innominata arteries.

SECTION III.

LIGATION OF THE CAROTID ARTERIES.

The ordinary position of an aneurismal tumor of the arteries in the neck, rendering it a difficult matter to keep up a steady pressure upon the main trunk, without also exposing the patient to the dangers of congestion of the brain from the proximity of the jugular vein to the artery, has prevented any attempts to cure these aneurisms by compression from being generally resorted to. The ligature has therefore been employed, whenever direct surgical interference was demanded.

The object of the applications of ligatures to the carotid artery being to cut off the circulation through the main trunk of the vessel, it is unnecessary now to mention the complaints which, in addition to aneurisms, may call for this operation, further than to say that wounds and erectile or other tumors constitute the greater number. Some of the various instruments employed for passing the ligature around arteries may be seen by referring to Plate XXXV., and are of course applicable to the carotid as well as elsewhere. But, to a dextrous operator, the selection of an aneurismal needle will prove a matter of but little moment, and any of them may therefore be taken, the choice being guided mainly by individual predilection.

History of the Ligation of the Carotid Artery.—In the various accounts furnished by surgical writers of the history of the ligation of the primitive carotid artery, it is generally stated that the first application of it, as an operation, was made by Sir Astley Cooper, in November, 1805,* the ligating of the vessel by Heberstreit and Abernethy having been consequent on wounds of the throat. It is, however, well known in the United States that, two years prior to the operation of Sir Astley Cooper, this important vessel had been effectually ligated by Mason F. Cogswell, of Hartford, Connecticut, who, in November, 1803, tied the carotid during the removal of a scirrhous tumor of the neck.† In this case, "the ligature separated from the artery on the 14th, and the patient did well until the 20th, when he sunk in consequence of a slight hemorrhage from a small vessel near the angle of the jaw, acting on a system enfeebled by a long-standing disease." It may interest the American student to know that this distinguished surgeon graduated at Yale College in 1780, and served in the United States army during part of the Revolution, with his brother, James Cogswell; commencing the civil practice of his profession in Hartford, in 1789. He died in 1830, in the 70th year of his age.* Since the first four cases of ligation of this vessel—by Abernethy, for a wound from the horn of a cow, in 1799; by Heberstreit, 1800, for the extirpation of a scirrhous tumor; by Cogswell, of Connecticut, for a tumor, in November, 1803, and by Fleming, in the same year, in a case of suicide—it has also been tied successfully by Travers, in 1804, for an aneurism in the orbit of the eye; by Sir A. Cooper, in 1805, for aneurism, the woman dying on the 19th day; and since then by very many surgeons in all sections of the globe. In the United States, the ligation of this artery was successfully performed for aneurism, by Wright Post, of New York, in 1817; by Mussey, of New Hampshire, successfully, in 1822; and by Sykes, of Delaware, successfully, in 1823. The ligature has also been placed upon both carotids by McGill, of Maryland, in 1825, successfully; by Mussey, of New Hampshire, at two days' interval, in 1829; by Mott, of New York, unsuccessfully, in 1834, both vessels being tied simultaneously; and by J. Mason Warren, on both vessels successfully—at an interval of five weeks—in 1846. Reference to the Bibliographical Index at the end of this part will also show that the single ligature has been very frequently practiced by other American surgeons, whose names are there given. Of these, few have been so frequently called on to perform it as Mott, of New York, he having, as I am informed, ligated the carotid artery for the thirty-second time.

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* Velpeau, Op. Surg., Am. edit. vol. ii. p. 236.
† Williams's Am. Med. Biog., p. 103.

§ 1.—Ligation of the Primitive Carotid Artery.

Operation of Mott, of New York.†—The skin, superficial fascia, and platysma-myodes muscle being cautiously divided on the inner edge of the sterno-cleido-mastoid muscle, on a level with the larynx, separate the edges of the wound with the fingers, and push the omo-hyoid muscle downward. Then, carefully picking up the deep fascia in the forceps, nick it, and, opening it on a director, seek for the descendens noni nerve, where it lies upon the sheath of the vessel, and, pushing it to one side, cautiously open the sheath of the artery, and pass the ligature around it by means of the Philadelphia needle—Plate XXXV. Fig. 2—which Mott prefers to all others. Any small vessels that may bleed during the incisions should be promptly tied in order to prevent the blood from obscuring the parts around the main artery.

Operation of Velpeau.—The plan recommended by Velpeau,‡ and by him designated as the ordinary operation, from its being pursued by nearly every surgeon, when circumstances admit it, is substantially as follows:—

Operation.—The patient being placed upon the back, with the chest slightly raised, the neck a little stretched, and the face inclined to the side which is opposite to the tumor, the surgeon should stand on the side of the aneurism, and feel for the anterior edge of the sterno-mastoid muscle, or for the depression which shows its border. Then placing upon it—as directed by Lisfranc—the four fingers of his left hand, all brought to the same level, let him make in this direction an incision about three inches in length, commencing on a line with the cricoid cartilage and terminating near the sternum, if he desire to tie the artery in the omo-tracheal triangle, that is, below the omo-hyoid muscle. But if the disease permits the artery to be tied in the omo-hyoid triangle—above the muscle—the incision should be carried a little higher up and not so low down. A second cut of the scalpel should then divide the platysma-myodes muscle and superficial fascia, and lay bare the fibres of the sterno-mastoid muscle, when an assistant may draw the inner edge of the wound toward the trachea, and the operator push its external edge outward by means of the first and second fingers of his left hand. The patient's head being then turned so as to relieve the extension and inclination of the neck, and relax the parts, the fibrous layer, which extends from the sterno-hyoid and thyroid muscles to the posterior surface of the sterno-mastoid—layer of deep cervical fascia—should be divided by raising and nicking in it a little opening, through which a director may be passed.

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* Williams's Am. Med. Biog., p. 109.

† New York Register of Med. and Pharmacy, vol. i. p. 93.

‡ Méd. Opératoire, tome i. p. 240.

The omo-hyoid muscle, being now seen as a reddish ribbon, may be divided upon the director, if it should be in the way of the operator, though generally this may be avoided by drawing it to one side. Above and below the line of the muscle will then be seen the yellow-looking sheath of the vessels, on the anterior surface of which is the descendens noni nerve. The sheath being picked up in the forceps over the artery—not over the vein—and slightly nicked, the director should be introduced and the sheath opened upon it to the extent of an inch. If the jugular vein swells up in expiration, so as to embarrass the operator, it should be compressed, as advised by Hodgson, near the superior angle of the wound, when it will soon empty itself and shrink.

When the sheath is opened, the artery, par vagum, and vein, in the order mentioned—counting from the trachea—will be exposed, when the aneurismal needle should be introduced between the vein and artery, so as to keep its point close to the artery, in order to avoid the par vagum nerve, and being by a slight rocking motion made to pass round the vessel, its point should be made to perforate any areolar tissue that opposes its exit, by the pressure of a finger of the left hand.

After the ligature is withdrawn, the artery may then be very slightly raised upon it, and tied by a double knot, both ends being left attached in order to favor the escape of any suppuration that may subsequently supervene. The wound should next be lightly dressed, and the patient placed in bed in such a position as will relax the parts, until the ligature separates, this happening sometimes in ten days, though often not till much later.

Remarks.—To avoid error in the first incisions, it has been advised to cut directly upon the belly of the sterno-mastoid muscle, and then to draw the wound toward the trachea, instead of cutting upon the inner edge of the muscle, as this, in the lower part of the neck, is liable to throw the operator upon the tracheal muscles instead of the sterno-cleido-mastoid. Chassaignac* has also advised the surgeon, in case of difficulty, to feel for the tubercle or projection made by the anterior branch of the transverse process of the sixth cervical vertebra—carotid tubercle—which is in front and a little inside the artery, if, in operating at the inferior third of the vessel, he finds the parts so infiltrated as to prevent their being recognized. I have tried this rule repeatedly upon the subject, and seldom failed to find the artery simply by the touch.

§ 2.—Effects resulting from Ligation of the Carotid.

When the circulation is cut off from one side of the head by the application of a ligature to the carotid artery, it is useful to know by what means nature remedies this obstruction to the natural course of the supply of blood intended for the head, and especially for the brain, as well as its effects upon this organ. From the free anastomosis found between the vessels supplying the head and upper part of the neck, it might readily be surmised that their enlargement would be the chief means employed by nature to compensate for the temporary loss occasioned by the operation, and such has been accurately found to be the result. From a dissection made by Mott,* of New York, of a subject whose arteries were injected after a death consequent on a pulmonary affection, three months and nineteen days subsequent to the operation, it appeared that the carotid, which had beeen tied, (right side,) had been entirely obliterated from the innominata to the angle of the jaw, leaving a firm ligamentous cord divided into two parts at the point where the ligature had been applied. The vein and nerve were found to be perfectly natural; the right subclavian artery enlarged to a size equal to that of the innominata; left carotid increased to twice its natural size, and its branches augmented in the same ratio. The branches arising from the right subclavian artery were also enlarged. The inferior thyroid was dilated in the ramus thyroidea, and the thyroideæ ascendens were twice their natural size; but the transversalis cervicis and transversalis humeri, though arising from the same trunk, retained their natural dimensions. The thyroidea ascendens was found mounting up the neck in a zigzag direction, forming many communications with the vertebral artery, and with the mastoid branch of the occipital. The left carotid artery was also equal in size to the innominata, and furnished the greater part of the blood to the right side, the superior thyroid, lingual, pharyngeal, and internal maxillary arteries inosculating with those of the opposite side, so as to have the appearance of continuous trunks. The mental, inferior labial, coronary, and facial were also found to anastomose freely with the same arteries from the right side. Although no direct mention is made of the condition of the right vertebral artery, there can be no doubt that it also participated in the enlargement seen in its parent subclavian, and thus materially aided the supply of blood to the brain by means of the circle of Willis.

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* Malgaigne, p. 155.

Notwithstanding the numerous facts cited to show that, in most instances, no serious disturbance of the function of the brain ensues upon ligation of the carotid,† yet the reverse has been noted, the failures having been ascribed to some disorder or anomalous arrangement of the arteries chiefly concerned in equalizing the circulation after the operation. In a patient operated on by Key, who died almost immediately, the left carotid was found to be nearly obliterated at its origin from the aorta. In a case treated by Langenbeck, the patient suddenly presented alarming symptoms, and died thirty-four hours after the operation, in consequence, as is *supposed*, of some abnormal condition of the arteria communicans. Three patients in the hands of Molina, of Mayo, and of Sisco, suffered more or less in the sight and hearing of the side operated on. A patient of Magendie, one of Baroven, one of Macauley, of Cooper, of Vincent and others, suffered from hemiplegia of the opposite side to that on which the artery was tied, thus indicating a lesion in the side of the brain corresponding with the artery.‡ It is better, therefore, in all cases, to watch the effect upon the patient after tying the first knot before forming the second, so that, if requisite, the ligature may be removed from the vessel.

Though the ligation of one carotid has occasionally created these serious results, it has been successfully practiced on both arteries, at intervals varying from two to six weeks, by McGill, Mussey, Mason Warren, Ellis, and Blackman in the United States, and by several surgeons in Europe, and in these cases it is to be presumed that the vertebral arteries were in good condition. In a case in which both carotids were ligated simultaneously by Mott for extensive disease of the parotid gland, the patient died in twenty-four hours.[*]

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* Amer. Journ. Med. Sciences, vol. viii. p. 45, 1831.

† Chelius, by South and Norris, vol. ii. p. 507.

‡ Dict. de Médecine, tome vi. article Carotide.

Death also ensued upon ligation of the primitive carotid by A. C. Post, of New York, one month after the operation, in consequence of phlebitis of the corresponding vein, pus being also found between the meninges of the brain.

§ 3.—Statistics of the Operation of Ligating the Carotid Artery.

The attention of surgeons having been closely bestowed upon the results of the application of a ligature to the carotid artery, we are now able to form a tolerably correct estimate of the consequences of this operation, and, without specifying the diseases which required it, the following table will show the data from which an opinion may be formed :—

TABLE.

	CURED.	DIED.	UNSUCCESSFUL.	DOUBTFUL.
Of 137 cases reported by Velpeau[†]…………	82	40	13	2
Of 128 cases reported by Norris, of Philadelphia,[‡] (in reference to the cure of the disease)…………	69	50	9	
Of 21 cases reported by E. Crisp[§]…………	10	11		
Of 7 cases reported by Lente, of New York[‖]…………	5	2		
Of 30 cases collected by myself, from the operations of surgeons in the United States…………	22	8		
Of 8cases of the ligature of both carotids…………	6	2 (simultaneous ligature.)		
Total of cases, 330…………	194	113	22	2

From this table it appears that in 330 cases, more than one-half of those operated on were cured.

Of the cases reported by Velpeau, 32 were by surgeons in the United States, of which 27 were cured.

Of those reported by Norris, 38 were performed in the United States, of which 28 were cured; and Lente and myself report only those performed by American surgeons, being 45 in all, (including those of both carotids,) of which 33 were cured.

Total of cases in the United States, 115; of which there were cured, 88.

Total of those in Europe, 216; of which there were cured, 106; showing a decided result in favor of the surgeons of the United States, either in consequence of their subsequent treatment of the case, or, what is more probable, the better constitution and habits of the patients operated on.

§ 4.—Ligation of the Lingual and Facial Arteries.

The ligation of the **Lingual** or **Facial** artery, though seldom required, may occasionally be demanded for the relief of tumors of the tongue or face, and may be accomplished as hereafter directed. Although rarely demanded dur-

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[*] Am. Journ. Med. Sciences, vol. xiv. p. 530, 1834.

[†] Méd. Opératoire, tome ii. p. 232.

[‡] Am. Journ. Med. Sciences, vol. xiv. N. S. p. 13.

[§] Lond. Med. Examiner, vol. ii. No. 3.

[‖] Transact. Amer. Med. Assoc., vol. iv. p. 326.

PLATE XXXVI.

OPERATIONS UPON THE NECK.

Fig. 1. Ligation of the Carotid, Lingual, and Facial Arteries. **C.** Ligation of the primitive carotid. 1. Lowest point of incision. 2. Fascia profunda. 3. Internal jugular vein. 4. Carotid artery raised on the aneurismal needle. 5. Par vagum nerve. **L.** Ligation of the Lingual Artery. 1. External incision. 2. Fascia. 3. Lingual artery. **F.** Ligature of Facial Artery. 1. External incision. 2. Fascia. 3. Facial artery. *After Bernard and Huette.*

Fig. 2. Surgical Anatomy of the Subclavian and Axillary Arteries. 1. Subclavian artery; as it passes from beneath the clavicle, it becomes axillary. 2. Axillary vein. 3 Brachial plexus of nerves. 4. Supra-scapular artery passing across the neck. 5. Omo-hyoid muscle. 6. Phrenic nerve. 7. External jugular vein. 8. Clavicular portion of sterno-cleido-mastoid. 9. Its sternal origin. 10. Clavicle sawed across. 11. Deltoid muscle. 12. Cephalic vein. 13. Pectoralis minor muscle. 14. Section of pectoralis major muscle.

After Bernard and Huette.

Fig. 3. Origin of the Carotid and Subclavian Arteries and Branches of the Subclavian. 1, 1. Aorta. 2. Innominata. 3. Primitive carotids. 4. Right subclavian. 5. Left subclavian. 6. Scalenus anticus muscle. 7, 7. Vertebral arteries. 8, 8. Thyroid axis. 9, 9. Posterior scapular arteries. 10, 10. Internal mammary. *After Bernard and Huette.*

Fig. 4. Ligation of the Subclavian and Axillary Arteries. **A.** Ligation of the subclavian. 1. Incision in skin. 2. Deep fascia. 3. Omo-hyoid muscle. 4. Brachial plexus. 5. Subclavian artery raised on the needle. 6. Scalenus anticus muscle. 7. Subclavian vein. **B.** Ligation of the axillary below the Clavicle. 1. Incision in skin. 2. Deep fascia. 3. Fibres of pectoralis major cut across. 4. Axillary artery raised on the needle. 5. Axillary vein.

After Bernard and Huette.

Fig. 5. Relative Position of the Subclavian Vessels. 1. Subclavian artery. 2. Subclavian vein. 3. First rib. 4. Scalenus anticus muscle.

After Bernard and Huette.

Fig. 6. A view of the operation of Œsophagotomy. 1, 1. Incision in the skin. 2. Deep fascia. 3. Blunt hook drawing the trachea inward. 4. The œsophagus. 5. Fingers of the surgeon drawing the blood-vessels outward, so as to protect them during the incision in the œsophagus. 6. Bistoury incising the œsophagus. 7. Sterno-cleido-mastoid muscle drawn aside. 8. Internal jugular vein. 9. Primitive carotid artery. *After Bernard and Huette.*

Plate 36.

Fig 3

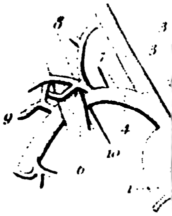

Fig 2

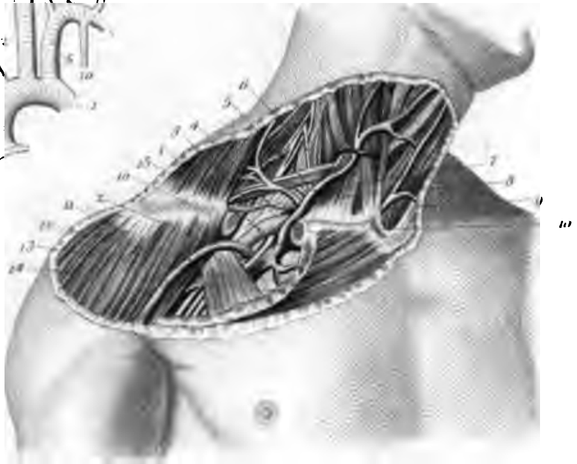

Fig 1

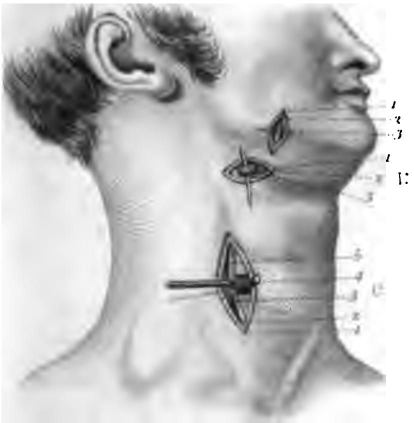

Fig 6

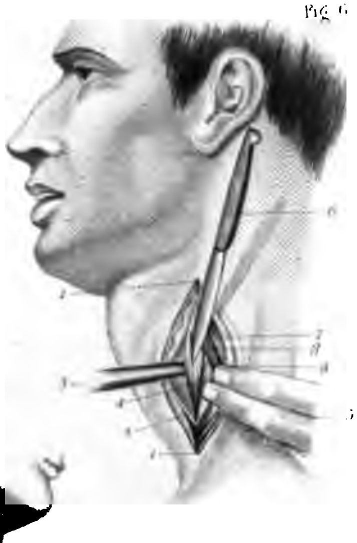

Fig 4

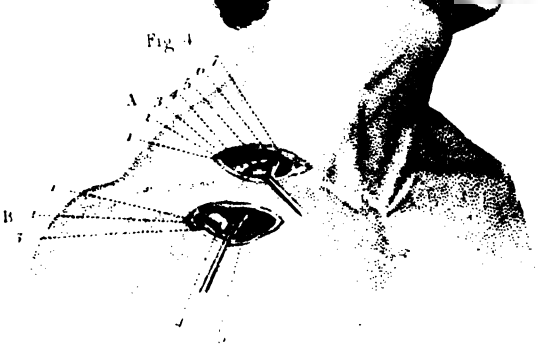

Fig 5

ing life, the ligation of these arteries upon the subject, and especially the lingual, will be found to be a good operative exercise, and worthy of repetition by the student.

I.—Ligation of the Lingual Artery.

Anatomical Relations.—The **Lingual artery**, after arising from the external carotid, will be found in the supra-hyoid region of the neck. In the early part of its course, it is concealed by the digastric and stylo-hyoid muscles; after which it penetrates the hyo-glossus muscle, just above the cornu of the os hyoides—which is the first point of reference—or between it and the middle constrictor of the pharynx. It then ascends between the hyo-glossus and the genio-hyo-glossus muscles, and, running forward, lies between the latter muscle and the sublingual gland, which is the second point of reference. It may be ligated most readily at its nearest point to the os hyoides, Plate XXXVI. Fig. 1.

Operation of Malgaigne.*—Feel for the greater cornu of the os hyoides, and make an incision, one inch and a half long, and parallel to the greater cornu, through the skin, fascia superficialis, and platysma-myodes muscle, taking special care not to divide the facial vein, which runs obliquely across the incision. After exposing the submaxillary gland, which is readily recognized, push it upward, and the bright tendon of the digastric muscle will be seen showing through the cellular tissue, half a line above which will be found the hypo-glossal nerve, which is to be drawn aside. Then, at one line below it, raise the hyo-glossus muscle carefully, and, dividing it transversely, the artery will be found directly beneath, unaccompanied by any vein or nerve. The first incision must not be extended too much toward the sterno-mastoid muscle, lest it involve the carotid region.

II.—Ligation of the Facial Artery.

Anatomical Relations.—The **Facial artery** arises from the external carotid, a few lines above the lingual, and goes forward within the angle of the jaw and above the submaxillary gland, with which it is closely connected, until it mounts over the base of the inferior maxilla just in advance of the anterior edge of the masseter muscle. When compression of the artery upon the jaw will not arrest the circulation on the side of the face, or when tumors about the submaxillary gland demand it, the ligation of this artery may be accomplished as follows, Plate XXXVI. Fig. 1:—

Operation.—Make an incision through the skin and fascia, an inch and a quarter long, obliquely across the jaw-bone, from the masseter muscle toward the angle of the mouth. Then, lacerating the connective tissue with the director, and pushing the accompanying veins to each side, apply the ligature carefully around the artery, so as not to include any nervous filaments.

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* Op. Surgery, Philad. edit. p. 155.

CHAPTER IX.

LIGATION OF THE INNOMINATA AND SUBCLAVIAN ARTERIES.

As a remedy for the relief of aneurismal tumors of the carotid, or of the subclavian artery close to the clavicle, the ligation of the innominata or of the subclavian within the scaleni muscles has been practiced. Before showing the plans that have been resorted to for the accomplishment of this object, a brief reference must be made to the relative position of the parts concerned.

SECTION I.

SURGICAL ANATOMY OF THE INNOMINATA AND SUBCLAVIAN ARTERIES.

The **Aorta**, in forming the arch which permits it to pass from the heart downward into the thorax, rises to within eight or twelve lines of the superior edge of the sternum, and at this point gives off the Innominata and the Left Carotid and Left Subclavian Arteries.

§ 1.—Anatomical Relations of the Innominata.

The trunk of the **Innominata artery**, which is from an inch to an inch and a half long, or rarely two inches, arises from the arch of the aorta as just stated, and extends to near the level of the sterno-clavicular articulation, where it gives off the right subclavian and right carotid arteries. In this short course it passes obliquely from below upward, from within outward, and from before backward; is very nearly in contact on its outer side with the top of the pleura; rests against the front and right side of the trachea; is crossed on its anterior face by the left transverse vein, and lower down by the vena cava descendens, which is parallel with it, but more and more distant as it approaches the heart.* It is covered by the skin, superficial and deep cervical fasciæ, by areolar tissue, by the origins of the sterno-hyoid and thyroid muscles, and by a portion of the sterno-clavicular articulation, Plate XXXVII. Fig. 3.

§ 2.—Anatomical Relations of the Subclavian Artery.

The **Subclavian artery** of the right side arises from the innominata, and that of the left from the arch of the aorta. Each crosses the first rib of its respective side in the interval between the scalenus anticus and medius muscles, and, passing between the subclavius muscle and the rib, escapes from under the clavicle, and is thence known as the **Axillary artery**. The right subclavian is much shorter and more superficial than the left from its origin to the scaleni muscles. Near these muscles, both arteries are covered in front by the sternal end of the clavicle; by the sterno-hyoid and thyroid muscles, and by the subclavian vein of the corresponding side. Behind them is the longus colli muscle; below them, the pleura, the left artery being in contact with it for its whole length in the thorax, and on their internal side is the primitive carotid artery. Near the scalenus anticus, the right subclavian artery is crossed by the par vagum nerve, while the phrenic nerve is found in front of it, but on the internal edge of the scalenus muscle.

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* Dict. de Méd., tome xxviii.

The **Left Subclavian artery** runs nearly vertically from its origin to the interval in the scaleni muscles; is nearly parallel to but behind the left primitive carotid; has the phrenic nerve in the same relative position as the artery on the right side, though the left par vagum goes parallel with and in front of the artery for some distance along its root. At the inner margin of the scaleni muscles, on both sides, is found the thyroid axis or cluster of five branches. The sympathetic nerve is generally behind the root of the artery on the right side, while on the left, the thoracic duct is very near its posterior face, and usually crosses it above before emptying into the left subclavian vein.

Having become horizontal, the subclavian arteries present the same relations on both sides, and lie directly on the first rib, the insertion of the scalenus anticus muscle separating them from the subclavian vein. All the nerves of the brachial plexus form a net-work around the arteries, resembling the plaiting of a whip-cord.

Outside the scaleni muscles, the subclavian artery corresponds to the supra-clavicular fossa, and rests upon the first intercostal space. The subclavian vein, which covers the artery while descending toward the clavicle, receives at this point the subscapular vein, external jugular, and sometimes the acromial veins. The brachial plexus accompanies the artery thus far, but soon afterward passes behind it. The artery is, therefore, generally found in a triangular space formed by the omo-hyoid muscle on the outside, the scalenus anticus on the inside, and the clavicle below.*

SECTION II.

LIGATION OF THE INNOMINATA ARTERY.

The difficulties attendant on the application of a ligature to the **Arteria Innominata** may be readily understood when reference is had to its anatomical relations, as well as to the changes likely to be created in the surrounding parts by the formation of such an aneurism as would lead to its execution. This operation has been performed ten times,† and in every instance resulted in death: to wit, first by Mott, of New York; second, by Græfe, of Berlin; third, by Bland; fourth, by Hall, of Baltimore; fifth, by Kuhl, of Leipsic; sixth, by Lizars, of England; seventh, by Arendt, of Russia; eighth and ninth, by Bujalski, of St. Petersburg; and tenth, by Hutin, for a wound.

In order to obviate the numerous difficulties attendant on this operation, various plans of proceeding have been recommended; but this account will be limited to the method of Mott, as it is generally admitted to expose the parts as freely as is safe, and is also sanctioned by the experience of Malgaigne and others, who regard it as the best that can be employed, if the operation should be again resorted to.

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* Horner's Anatomy, vol. ii. p. 215.

† Dict. de Méd., tome xxviii. p. 448.

The appearance of the tumor, and the incisions required in the operation, are shown in Plate XXXVII. Fig. 2, for a special drawing of which I am indebted to the politeness of Dr. Mott, it being believed by him to do justice to the appearance of the parts.

Operation of Mott, of New York, May 11, 1818.—The patient being placed in a recumbent position upon a table of the ordinary height, a little inclining to the left side, so that the light might fall obliquely on the upper part of the thorax and neck, and the surgeon seated on a bench of convenient height, an incision was commenced upon the tumor just above the clavicle, and carried close to this bone and the upper end of the sternum, so as to terminate immediately over the trachea, the whole cut being about three inches long. Another incision, about the same length, being then made from the termination of this along the inner edge of the sterno-mastoid muscle, the integuments were dissected back from the platysma-myodes muscle, beginning at the lower angle of the incision, when the flap was turned over upon the tumor and side of the neck.

After cutting through the platysma-myodes, the sternal origin of the sterno-mastoid muscle was cautiously divided in the direction of the first incision, and also reflected from over the tumor—Plate XXXVII. Figs. 2 and 3—when the sterno-hyoid muscle was divided, and then the sterno-thyroid, both being turned up on the opposite side of the wound over the trachea, so as to expose the sheath of the carotid artery. This sheath being now cautiously opened a little above the sternum, the nerve and vein were drawn to the outside, the artery drawn toward the trachea, and the subclavian laid bare about a half inch from its origin, the handle of the scalpel being mostly employed in order to avoid injuring these parts.

While separating the connective tissue from the artery with the smooth handle of the scalpel, a branch of an artery was lacerated, which yielded for a few minutes a smart hemorrhage. It was about half an inch distant from the innominata, and about the size of a crowquill; but the bleeding ceased upon a little pressure.

The bifurcation of the innominata being now in view, the dissection was mainly done with Parrish's knife—Plate XXXV. Fig. 1—care being taken to keep it directly over and along the upper surface of the artery. After fairly denuding the vessel on its upper surface, the connective tissue was very cautiously separated from the sides of it by the handle of the scalpel, so as to avoid injuring the pleura, and a round silk ligature being passed by means of the Philadelphia needle—Plate XXXV. Fig. 2—the artery was tied about half an inch below its bifurcation, the recurrent and phrenic nerves being undisturbed.

In introducing one of the smallest blunt needles—Plate XXXV. Fig. 5—around the artery, the instrument was passed from without inward, so that the areolar substance and the pleura could be pressed down with a part of the instrument, while the point was very carefully insinuated under the artery from below upward, so as to appear on the opposite side of the artery. The hook—Plate XXXV. Fig. 9—being then introduced into the eye of the needle, the shank was unscrewed and the needle drawn through with the utmost facility, leaving the ligature *in situ*, after which the knot was gradually tightened.

The integuments being then closed tightly, the patient was put to bed, with a pulse beating sixty-nine, ten minutes after the operation.

This patient subsequently did so well that, on the fourteenth day, the ligature separated. On the twentieth day he walked several times across the yard; but on the twenty-third day was attacked with hemorrhage from the wound, which returned at intervals, till on the twenty-sixth day after the operation, he died.*

Remarks.—The want of success attending the performance of this operation in so many able hands—it having resulted fatally in every instance—has generally proscribed the operation from the list of those that are justifiable in cases of aneurism.

The dissection of Mott's patient showed that a firm clot had formed in the artery below the ligature, and that ulceration of the opposite side of the artery was the source of the hemorrhage. Græfe's operation in 1822 apparently did well for sixty-eight days, but then hemorrhage ensued upon the patient's exerting himself. Blandin, in 1837, lost his patient by hemorrhage on the eighteenth day. Hall lost his on the sixth day, also by hemorrhage; and the patient of Lizars died, in ten days, of hemorrhage, the chest containing twenty ounces of blood, the subclavian artery alone being diseased. Judging from these results, Velpeau has therefore expressed the decided opinion "that the operation ought not to be attempted, at least for the cure of aneurism."†

The little success that has followed this operation renders a reference to the operations of Brasdor and Wardrop, or the application of a ligature on the distal side of the tumor, essential to a knowledge of the best method of treating aneurisms of this vessel, and it should be deliberately considered before repeating the ligation of the innominata. According to Wardrop's views, the cure of an aneurism of the innominata by the application of a ligature to either the subclavian or the common carotid artery, corresponds with the course taken by nature in effecting the cure, as is shown in several preparations now in the Museum of the Royal College of Surgeons. In addition to which Wardrop has collected eight cases of aneurism of this vessel thus operated on, in five of which there was consolidation and diminution of the tumor, and though in three others the operation failed, one lived a month, the second died in a few hours, and the third was benefited for the time, only dying on the increase of the tumor. This success, as compared with that consequent on the ligation of the innominata itself, is certainly very great, and his method of treatment should, therefore, receive that consideration which so serious an operation must certainly obtain in the mind of every judicious operator. In selecting one of two vessels—either the subclavian or the carotid—Wardrop prefers the carotid; as this vessel was found in his preparation to be the one most frequently obstructed by the natural formation of a clot.

SECTION III.

LIGATION OF THE SUBCLAVIAN ARTERY.

The ligation of the **Subclavian artery** is an operation which dates back only to the commencement of the present century, having been first successfully performed by Keate, of England, in March, 1800; by Ramsden unsuccessfully in 1809; after which it was successfully ligated in 1815 by Chamberlaine, and then by Wright Post, of New York, in September, 1817,‡ this being the first time the operation was performed in the United States. Since this period, it has been frequently attempted both in Europe and the United States, being performed by Dudley, of Lexington, in 1826; by Gibson, of

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* Mott's Velpeau; also Eclect. Repertory, vol. ix.

† Dict. de Méd., tome xxviii. p. 474.

‡ Norris, Am. Journ. Med. Sciences, vol. x. N. S. p. 14.

PLATE XXXVII.

OPERATIONS PRACTICED ON THE LOWER PORTION OF THE NECK.

Fig. 1. A view of the operation for the Strangulation of a large Goitre which was inducing suffocation, as performed by Liston. By a crucial incision the skin has been dissected from the tumor, which was then caused to slough off by strangulating it by means of ligatures carried through and around its base by needles. This tumor sloughed off in eight days. 1. Sterno-hyoid and thyroid muscles divided and turned down. 2. Upper portion of the same. 3. Os hyoides. 4, 4. Enlarged veins on the surface of the tumor. *After Liston.*

Fig. 2. A view of Mott's operation for Ligation of the Innominata. 1. Aneurismal tumor of the subclavian. 2. Skin and platysma-myodes turned back. 3. Section of sternal origin of sterno-cleido-mastoid muscle. 4. Arteria innominata. *After Mott.*

Fig. 3. View of the relative position of the parts concerned in this operation. 1. Vertical incision. 2. Corresponding edge of skin. 3. Flap everted. 4. Sterno-mastoid muscle. 5. Arteria innominata. 6. Internal jugular vein. 7. Origin of subclavian artery. 8. Vertebral artery drawn forward. 9. Inferior thyroid artery. 10. Internal mammary. 11. Transversalis cervicis artery. *After Bourgery and Jacob.*

Fig. 4. A view of the position and arrangement of the Blood-vessels and Nerves of the Neck, as shown by turning off the Clavicle. 1. Trapezius muscle. 2. Sterno-cleido-mastoid. 3. Sterno-thyroid muscle and thyroid gland. 4. Upper portion of sternum. 5. Omo-hyoid muscle. 6. One of the cervical ganglia of the sympathetic nerve. 7. First cervical plexus. 8. Right primitive carotid. 9. Subclavian vein. 10. Ligature on the subclavian artery. 11. Hook holding down the internal jugular vein. 12. Hook holding the par vagum nerve. 13. Branches of the spinal accessory nerve. 14. Section of the second rib. 15. Phrenic nerve. 16. Aneurismal tumor of the subclavian artery. *After Auvert.*

Fig. 5. Surgical anatomy of the vessels just above the clavicle, as connected with the ligation of the Subclavian Artery. 1. Incision in the skin. 2. Scalenus anticus muscle. 3. Omo-hyoid. 4. Subclavian vein. 5. External jugular vein. 6. Transverse cervical. 7. Superficial artery. 8. Subclavian artery outside the scalenus muscle. 9. Supra-clavicular nerves. 10. Roots of the brachial plexus. 11. Phrenic nerve. *After Auvert.*

Fig. 6. Excision of the clavicle as performed by Warren. The skin has been turned back by a crucial incision, and the bone, being sawed across near its humeral end, is represented as raised by a ligature so as to favor its disarticulation. *After nature.*

Plate 37

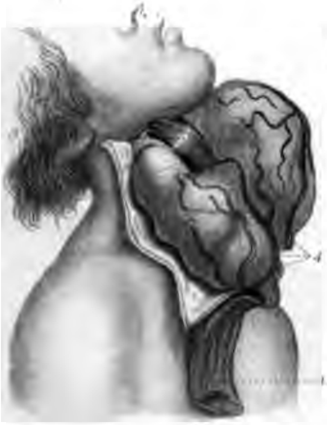
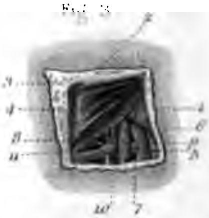


Fig. 3



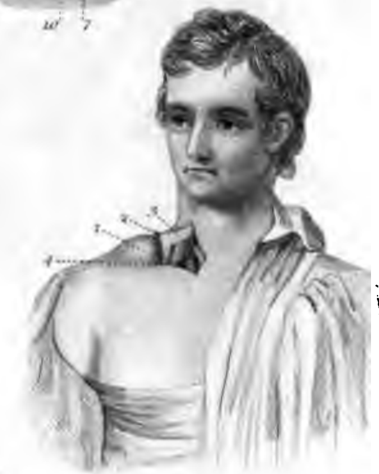


Fig. 7

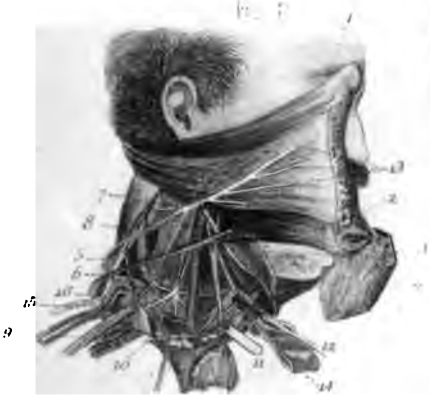
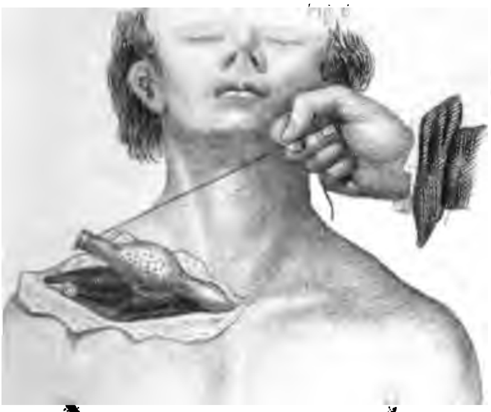
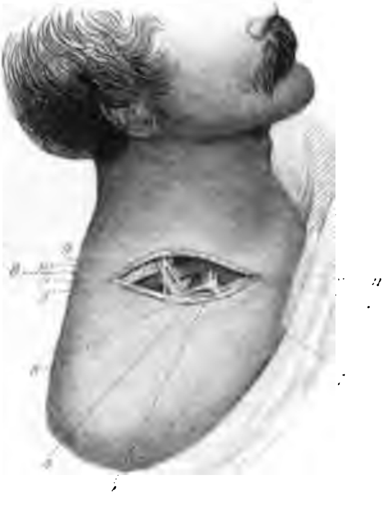


Fig. 6





Philadelphia, in 1828; by Wells, of Carolina, in 1828; by Mott, of New York, in 1831; by the same surgeon within the scaleni, in 1833; also by him upon the left subclavian, outside the scaleni, in 1834; and by Kearny Rodgers, of New York, within the scaleni muscles, in 1845, this being the first operation ever performed at this point. By a reference to the Bibliographical Index at the end of this part it will also be seen that many other American surgeons have succeeded in ligating the artery at the usual place.

The ligation of the subclavian artery may be performed in any portion of its course, though it is generally admitted to be accompanied by many difficulties, and to require perfect anatomical as well as surgical skill, no matter what portion of it may be chosen.

Three different points have been selected for the application of this ligature, the choice being usually directed by the necessities of the case. These points are usually designated as the operation upon the first rib, that between and that within the scaleni muscles, the difficulties being greater in most of them when it is necessary to operate upon the artery of the left side. As the clearest account of the operative proceedings, I have selected those furnished by Malgaigne and Velpeau, adding to them a few of the steps taken by the American surgeons whose cases are referred to in the Bibliographical Index at the end of this part.

To expose the artery on the first rib, it is necessary to divide "the skin, subcutaneous areolar tissue, superficial fascia, and platysma-myodes muscle; the fascia profunda colli, and a loose connective tissue full of venous branches and lymphatic ganglia, in which run two important arteries, the transversalis cervicis being placed some lines above the subclavian and the superior scapular, running along the posterior border of the clavicle. Sometimes the sterno-mastoid muscle, from its wide origin along the clavicle, requires division, while the external jugular vein, from running more outward than usual, requires to be avoided."*

In the latter stages of the operation, the following test of the position of the artery, which I have never known to fail, and which was suggested originally by Parrish, of Philadelphia,† will prove valuable, and that is, to notice the position of the tubercle or prominence on the first rib into which the scalenus anticus muscle is inserted, as the artery is invariably found on its outer side.

In the directions usually given by the French surgeons for the ligation of this artery, much stress is laid by them upon the importance of recognizing this prominence of the first rib as a point of reference, and on many occasions in which I heard it referred to at Clamart, and the Ecole Pratique of Paris, in 1839, I supposed that the suggestion was due either to Lisfranc, Velpeau, or Malgaigne, especially as the latter also mentioned it in his Manual of Operative Surgery. Subsequent reading has, however, induced me to think that this valuable direction originated in the United States, with Parrish, of Philadelphia, though, as I am unable to find any date in connection with the accounts of the French surgeons, I cannot be positive on the subject. A perusal of Parrish's paper‡ will, however, show that he published the description of this important land-mark to the position of the artery in the year 1813, four years after Ramsden's operation, and this, I think, is the earliest notice taken of an infallible rule for finding the artery.

The high estimate generally entertained of the accuracy of this point of reference renders it desirable to credit correctly the author of the suggestion, and in claiming it for Parrish, there is every reason to think that nothing more than justice is done to the memory of a surgeon whose experience as an operator is well known throughout the United States.

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* Malgaigne, Philadelphia edit. p. 148.

† Eclectic Repertory, vol. iii. p. 240. Philadelphia, 1813. ‡ Ibid.

§ 1.—Ligation of the Subclavian Artery on the First Rib.

Parrish's Rule for Finding the Subclavian Artery.—The depth at which the subclavian is placed rendering it very difficult to recognize the position of the vessel by the sight alone, the suggestion of Parrish, Hewson, and Hartshorne, referred to in Parrish's paper, will prove highly serviceable. It is as follows: After dividing the external tissues, pass the finger down to the superior edge of the first rib, and, sliding it along this toward the sternum, feel for the insertion of the scalenus anticus muscle. The tubercle at this point is very perceptible to the touch, and the artery will be found close upon its outer side.

Ordinary Operation.—The patient lying down with the head secured and the shoulder drawn downward and slightly forward so as to depress the clavicle, make an incision immediately above the bone parallel to its posterior border, commencing one inch outside its sternal end, and extending to the insertion of the trapezius muscle, and, after cautiously dividing the skin, draw the external jugular vein, if it shows itself, inward, by means of a blunt hook. Then, cutting across the superficial fascia and platysma-myodes muscle, cautiously open the fascia profunda colli, and, laying aside the knife, tear the connective tissue with the finger-nail or point of the director. On carrying the forefinger into the internal angle of the wound, feel, as directed by Parrish, for the scalenus tubercle of the first rib, and, reaching it, the artery will be felt pulsating on its external side. Then, while keeping the finger upon this tubercle as a guide, pass the aneurismal needle carefully under the vessel from its inner side, and bring it out externally, holding the artery with the finger to prevent its slipping; and, placing a finger between it and the first fasciculus of the brachial plexus of nerves, so as to preserve them from injury, facilitate the passage of the needle by depressing the shoulder and turning the patient's head to the opposite side.*

Remarks.—As this method of operating exposes the surgeon to the risk of wounding the external jugular vein, Roux advises that the incision should be made perpendicularly to the clavicle, and I have found his mode of operating quite easy upon the subject.

A somewhat similar, but more accurate method of operating, is as follows:—

Method.—Make an incision perpendicular to the clavicle by dropping a line from the point where the anterior edge of the trapezius and posterior margin of the sterno-mastoid muscle meet, (supra-clavicular fossa,) so as to divide this triangular depression into two triangles, and then dissect or lacerate the tissues until the artery is distinctly felt.

Remarks.—This mode of reaching the subclavian was suggested since, by Horner, of Philadelphia, and protects the surgeon not only from the risk of wounding the vein, but also from injury of the transvere vessels, so often found near the subclavian artery, should the transverse incision fall too near the sternal end of the bone.

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* Malgaigne.

§ 2.—Ligation of the Artery between the Scaleni Muscles.

Operation of Dupuytren.—Make at the base of the neck a transverse incision extending from the anterior edge of the trapezius to the inner border, or to a short distance upon the outer side of the sterno-mastoid muscle, cutting through the different layers as before mentioned. Having found the insertion of the scalenus anticus, insinuate between its posterior surface and the front of the artery a grooved director, and divide the muscle upon it, when the retraction of the muscle will lay bare the artery, and enable the needle to pass under it from without inward.*

Remarks.—In this operation, caution has always been given respecting the position of the phrenic nerve, which, it will be recollected, lies against the internal side of the scalenus anticus and a little anterior to it. But Malgaigne† also advises that attention should be given to the internal mammary artery which runs outside of this nerve, and is much exposed if the cut is made too near the rib.

§ 3.—Ligation of the Subclavian Artery within the Scaleni Muscles.

This operation, which was first performed by Colles, of Dublin, who lost his patient on the eighth day, has since been repeated several times in Europe and this country, Mott, of New York, performing the second operation.

Operation of Mott on the Right Subclavian Artery.‡—The patient being placed upon the table, with the shoulders elevated, the head thrown backward, and the face and body inclined to the left side, an incision was begun at the lower part of the outer edge of the sternal origin of the sterno-mastoid muscle, and carried upward about two inches. Another, commencing at the same point, was then made along the upper surface of the clavicle for the same extent. When the triangular flap of skin, with the corresponding portion of the platysma and its investments, was separately dissected and turned aside, the clavicular portion of the mastoid muscle was severed immediately upon its insertion, and reflected upon the neck. This laying bare the deep-seated fascia, the latter was raised with the forceps, and divided a little below the course of the omo-hyoid muscle, on the outside of the deep jugular vein. On enlarging this opening an inch downward, the adipose and connective tissues were readily pushed aside, and the scalenus anticus muscle exposed to view. The connective tissue being now separated with the fingers and handle of the knife, the artery was exposed just within the thyroid axis, the branches of which could be plainly seen. The sheath being then raised from the artery with the forceps and cautiously divided, the ligature was passed under the vessel from below upward by Parrish's needle, curved spatulæ being employed to draw the deep jugular vein toward the trachea as well as to separate the edges of the wound. Three small arteries were tied; no vein required the ligature; but on the eighteenth day the patient died of secondary hemorrhage.

§ 4.—Ligation of the Left Subclavian Artery within the Scaleni Muscles.

Although the right subclavian artery has been occasionally ligated on the cardiac side of the scaleni muscles, J. Kearny Rodgers, of New York, was,

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* Velpeau.

† Malgaigne, Philadelphia edit. p. 150.

‡ Amer. Journ. Med. Sciences, vol. xii. p. 354, 1833.

I believe, the first surgeon who succeeded in tying the **Left Subclavian** within these muscles, such an operation being regarded as impracticable prior to his case. It was performed under the following circumstances:—

A German, forty-two years of age, was admitted September 13, 1845, into the New York Hospital, with an aneurismal tumor above the clavicle, about the size of a small hen-egg, extending externally to the outer third of the bone, and covered internally by the outer edge of the sterno-mastoid muscle. A consultation having left the decision of an operation to Rodgers, this gentleman concluded, after mature reflection, that the operation was possible, and therefore determined to try it.

Operation of J. Kearny Rodgers.*—The patient being placed on a low bed, with his head and shoulders raised, and his face turned to the right side, so that the light from the dome could shine directly on the part to be operated on, an incision three inches and a half long was made on the inner edge of the sterno-mastoid so as to terminate at the sternum, and divide the integuments and platysma-myodes. This was then met by another incision, which extended along the sternal extremity of the clavicle, about two and a half inches, and divided a plexus of varicose veins which were in the integuments covering the clavicle, and communicated with the subclavian vein. To check the free bleeding which occurred from their cut extremities, it therefore became necessary to tie them.

The flap of integuments and platysma-myodes being now dissected up, and the lower end of the sterno-cleido-mastoid laid bare, a director was passed under this muscle, and the sternal as well as half of its clavicular origin divided by a bistoury. This muscle being now turned up, the sterno-hyoid and omo-hyoid muscles, as well as the deep-seated jugular vein, were seen covered by the deep cervical fascia.

On turning up the sterno-mastoid, a portion of the aneurismal sac was seen strongly pulsating and overlapping about half the width of the scalenus, so as to form the outer half of the track, through which it was necessary that the operator should pass, showing fearfully one of the dangers of the operation, but one which Rodgers had anticipated. The deep fascia being then divided by the handle of the scalpel and the fingers, the dissection was continued in contact with the outer side of the deep jugular vein to the inner edge of the scalenus anticus muscle, for the purpose of reaching this muscle fully half an inch above the rib, instead of at its insertion, in order to guard against any injury to the thoracic duct. The phrenic nerve could now be distinctly felt running down on the anterior surface of the scalenus, and was of course avoided, until, by pressing the finger downward, the rib was discovered, when after some little search the position of the artery was recognized. By pressing the vessel against the rib, all pulsation in the tumor ceased, while on removing the finger the pulsation returned. In order to avoid any injury tc the pleura and thoracic duct in detaching the artery, Parrish's needle was employed after that of Sir Philip Crampton had been tried, the point of the former being introduced under the artery, and directed upward so as to avoid the pleura. The needle being detached from the shaft of the instrument, the ligature was drawn upward so as to surround the artery, and then tightened with the forefingers at the bottom of the wound, all pulsation ceasing immediately in the tumor, and also in the arteries of the extremity. Warmth was subsequently applied to the limb, and the usual treatment pursued. On the thirteenth day, the patient, on changing his position from the right side to his back, was attacked with hemorrhage, of which he died two days subsequently, or fifteen days after the application of the ligature. A *post-mortem* examination, after detailing other points, established the inaccuracy of one fact, which had been previously urged as an argument against the operation, to wit, the chances of hemorrhage from the want of sufficient adhesions in the artery. In this case there was a perfect coagulum found in the vessels; the hemorrhage had come from the distal end of the artery in consequence of the free communication of the internal carotid at the base of the brain with the vertebral, the latter vessel having been given off from the subclavian just beyond the point where Rodgers had applied his ligature. Decidedly the greatest danger in the operation was thought by the operator to be the risk of wounding the pleura and the thoracic duct.

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* Am. Journ. of Med. Sciences, vol. xi. N. S. p. 541.

§ 5.—Statistics of the Operation of Ligation of the Subclavian Artery.

Of sixty-nine cases reported by Norris, of Philadelphia,* thirty-six recovered and thirty-three died, or a few more than one-half recovered. Of fifty-four cases, in which the affected side is mentioned, thirty-one were on the right and twenty-three on the left side.

Of the fifty cases reported by Velpeau†—several of which have been also counted by Norris—twenty-three died and twenty-seven were cured. Of the twenty-three cases in which the left artery was tied, as reported by Norris, fifteen were cured and eight died; but there is no mention made of any of these having been performed on the left side within the scaleni muscles.

Of twenty-six cases of aneurism reported by Crisp,‡ ten were ligated successfully, one was cured by pressure, and five died, after the application of the ligature, from hemorrhage.

Of eighteen cases of the ligation of the subclavian collected by myself, fourteen were cured and four died. Of seventeen performed in the United States, and reported by Norris, eleven were cured and six died. Of the thirty cases, therefore, in the United States, twenty-one were cured and nine died.

On summing up these one hundred and fifty-eight cases, eighty-three are mentioned as cured, out of the whole number reported in the tables. It appears, therefore, that the successful cases have been four more than one-half of those operated on, but that the ligation within the scaleni muscles has been by far the most fatal of all, the deaths ensuing chiefly from hemorrhage or from inflammation of the pleura or pulmonary organs.

The anatomical relations of the pleura to these arteries sufficiently explain this result.

§ 6.—Anatomical Phenomena Consequent on the Ligation of the Subclavian Artery.

After applying a ligature to a large artery, and thus for a time cutting off the supply of blood from the extremity which it has previously nourished, it becomes a matter of some interest to learn in what manner nature can adapt herself to the change, and remedy the evil that it might be supposed would ensue. The following account, furnished in connection with the dissection of two of the operations practiced on the subclavian, will therefore, it is thought, prove instructive to the student by exhibiting the anatomical changes consequent on the obstruction caused by the ligation of the main channel of this artery.

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* Am. Journ. Med. Sciences, vol. x. N. S. p. 18.
† Operat. Surgery, by Mott, vol. ii. p. 219.
‡ London Med. Examiner, No. 8, vol. ii. p. 209.

In the account of the autopsy—furnished by Ainsworth,[*] of Boston—of a patient on whom a ligature had been applied (four years previously) to the left subclavian artery at the external border of the scalenus anticus muscle, we find "that the injecting matter which was thrown into the aorta of the subject passed readily into all the vessels of the left arm and hand; that the arteries and veins of the neck, as well as the brachial plexus of nerves for the space of three inches above the clavicle, were imbedded in a dense fibro-cartilaginous substance, and that the subclavian artery was completely obliterated and reduced to a mere fibrous-looking cord at the point where the ligature had been applied. Three-fourths of an inch from this spot the vessel, however, nearly regained its usual size, and continued throughout its whole course of the normal dimensions and distribution, the collateral circulation being maintained by the intercostal branches of the internal mammary through the thoracic branches of the thoracico-acromialis, and by a large inosculation between the supra-scapular and a terminal branch of the sub-scapular arteries. A communication was also traced between some small muscular branches of the transverse cervical and the thoracico-acromialis. An irregularity which is not uncommon was also noted in the transversalis cervicis artery, which was given off from the thyroid axis in a common trunk with the posterior scapular, and formed a large trunk, which, running parallel to the clavicle, so as to correspond at first with the course of the subclavian, might readily have been wounded or ligated in mistake for the subclavian itself." From the information furnished by the dissection of another anomalous distribution in these vessels, Ainsworth suggests that it may be well hereafter to secure both extremities of the main artery so as to avoid the hemorrhage that has sometimes ensued in the operation from the collateral circulation.

In the report of the dissection of a patient operated on by J. Mason Warren[†] for the ligation of the left subclavian, one year previous, it was shown that the subclavian was of its original size as far as the scalenus anticus, where it suddenly terminated, while the vessels forming the thyroid axis were twice their natural size, the internal mammary being enlarged and given off from the thyroid. It was through this vessel, by means of the inosculation of the intercostal arteries with the thoracic, and of the posterior scapular with the sub-scapular, that the collateral circulation had been accomplished.

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[*] Am. Journ. Med. Sci., vol. xix. N. S. p. 84.

[†] Ibid., vol. xxi. N. S. p. 53.

CHAPTER X.

OPERATIONS UPON THE CHEST.

SECTION I.

SURGICAL ANATOMY OF THE CHEST.

THE extent of the **Chest** as a surgical region is usually regarded by anatomists as limited, above, by a circular boundary formed by the upper extremity of the sternum, the first rib and first dorsal vertebra, or, in other words, by the bony constituents of the thorax; and below, by the curved line formed in the arrangement of the cartilages of the ribs, the chest being at this point completely separated from the abdomen by the diaphragm.

There is, however, a portion of the body, of great importance to the surgeon, which is not included in these limits, and which is yet not included in those assigned to the upper extremities, to wit, the structures about the clavicle; and it will, therefore, answer better for the purposes of description, at present, to define the chest as that portion of the body intermediate to the neck and abdomen, the upper portion being intimately connected with the upper extremities, but the lower separated entirely from the abdomen by the diaphragm. As most of the constituents of this section of the body are unimportant, consisting merely of skin and muscle, they do not present any points requiring either a precise regional description or a minute account of their connections with subjacent parts. The reader may therefore be referred, for their description, to the anatomical account of this part which every one gains in the course of a medical education. As its surgical details are also limited, such a brief account as may readily be presented in connection with the operations performed upon it is all that is at present demanded.

§ 1.—Surgical Anatomy of the Portion of the Chest about the Clavicle.

The **Clavicle,** being fixed by the articulations at its sternal and acromial extremities, has for its function the preservation of the pectoral space, or the steadying of the shoulder, and the prevention of its approach to the sternum. At each of its extremities is found a perfect joint amply supported by ligaments, in addition to which may be noted two other ligaments, that are upon its under surface, and tend to hold the bone in its proper relations to the ribs, to wit, the costo-clavicular or rhomboid ligament, which, arising from the cartilage of the first rib, is inserted into the roughness on the under surface of the clavicle near its sternal extremity, and the coraco-clavicular or conoid ligament, which, arising from the coracoid process of the scapula, is inserted into the tubercle near the inferior and external surface of the bone. The ligamentum bicorne, or bifid ligament, is so closely connected with the subclavius muscle, that it may be regarded chiefly as its fascia, and a further account of it omitted.

The **Muscles** connected with the clavicle above are a portion of the sterno-cleido-mastoid at its sternal extremity, and a part of the trapezius at its humeral end, while the pectoralis major and part of the deltoid are in front, and the subclavius muscle below. The latter muscle, arising from the cartilage of the first rib, is inserted into the inferior face of the clavicle, from near the sternum to the conoid ligament, and therefore draws the clavicle toward the rib.

The **Subclavian artery** and **vein** are both placed between this muscle and the first rib, the vein being close to the artery, but in front of it.

The **Brachial Plexus of Nerves** extends from the scaleni muscles to the axilla, passing along with the artery between the subclavius muscle and the rib. It has the axillary vein in front of it, but the different nerves surround the artery, as if plaited.

The fascia superficialis of the chest and neck, together with the skin, complete the coverings of this part.

SECTION II.

RESECTIONS OF THE CLAVICLE.

The **Resections** practiced upon the clavicle are such as are demanded for the relief of caries, necrosis, or osseous tumors, and may require either a partial or perfect division or resection of the bone. In describing the operation of resection of this bone, as well as in similar operations on other bones of the extremities, the reader should bear in mind that by the term "resection" is generally understood the removal of either a part or the entire structure of the bone, in such a manner as will yet permit the patient to have more or less use of the extremity to which it is attached. Any operation, therefore, which destroys this use, or removes the limb, is to be regarded as an amputation and not as a resection.

That this definition of the operation of resection is correct, is apparent from the views expressed by the following excellent authorities. Thus, J. Cloquet and A. Berard,* in speaking of the peculiar characters of a resection, state that "the preservation of the soft parts constitutes the special character of this operation, which should be practiced so as to avoid all lesion of the arterial or venous trunks, and injure the muscles and tendons as little as possible." Again, they say: "It is for this reason that resections of the superior extremity, by preserving to a certain extent the motions of the limb, are superior to amputations."†

Malgaigne, who is also good authority, remarks, when speaking of resections, that "we comprise under this title the removal of the articular extremities of bones, the resection of the long bones in their continuity, and the extirpation of certain bones entire, *without amputation of the soft parts.*"‡ All operations, therefore, which have not been performed with these restrictions, should be strictly excluded from this class. The rules adapted to the performance of all resections will be given hereafter in the operations on the extremities.

§ 1.—Resection of the Entire Clavicle.

The removal of the clavicle, either entire or in part, is an operation that has been occasionally found necessary or expedient, in consequence of the development of osseous or enchondromatous growths upon it, and their encroachment upon adjacent parts, or for the relief of necrosis; the cases of caries demanding rather the healing of the ulcer than the resection of the bone. Although the function of the clavicle appears to be essential to the proper action of the upper extremity, its removal has been accomplished without materially impairing the utility of the limb.

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* Dictionnaire de Med., tome xxvii. p. 402. † Ibid., p. 411.

‡ Op. Surg., Phil. edit. p. 188.

When in this resection it is found possible to retain a portion of the periosteum, it should always be left, as in the operation performed by the celebrated French surgeon Moreau for necrosis, where, although the entire clavicle was removed, yet at the autopsy of the patient, made several months subsequently, the bone was found to have been entirely regenerated, so as to preserve its relations with both the sternum and scapula. There is, however, reason to think, from the account furnished of this operation, that it was rather the removal of a sequestrum resembling the former clavicle, than a resection, and that the old bone, like the sequestra of other bones in a certain stage of necrosis, had been incased by the new osseous deposit consequent on the efforts of nature to remedy the disease, and hence the formation of the new clavicle.

The only cases of entire resection of the bone, not consequent on amputation, that I have been able to find recorded as performed in the United States, are one by Charles McCreary, of Kentucky,* who, in 1813, removed the entire clavicle for a scrofulous affection of the bone, without impairing the functions of the limb, the patient living for thirty-five years subsequently without any return of the disease; one by Mott, of New York, in 1819; one by Wedderburn, of New Orleans, in 1832; and one by Warren, of Boston, in 1833.

In Europe, Travers removed a large portion of the clavicle, leaving only the sternal end, in a boy who twelve months subsequently had the free use of his arm; and Chaumet, of Bordeaux, also removed four-fifths of the bone, on account of a tumor which originated in it, while Meyer and Roux operated on it in consequence of caries. The most perfect and difficult resections of this bone in its continuity, unconnected with amputations, are therefore those just referred to as performed by the four American surgeons above named.

Extirpation of the Entire Clavicle, by Mott, of New York.—A young man, nineteen years of age, had a conical tumor to form on the left clavicle, without his being able to assign for it any cause. At the time of the operation it was about four inches in diameter at its base, of an incompressible hardness, firmly attached to the anterior portion of the bone, and with its apex covered with luxuriant fungous granulations, the consequence of former means of treatment, from which profuse hemorrhage took place from time to time.

Operation of Mott.—An incision being commenced over the sterno-clavicular articulation, was carried in a semilunar direction in the sound integuments, to near the junction of the clavicle with the acromion process of the scapula, exposing the fibres of the pectoralis major muscle. These fibres were then carefully divided, so as to avoid injuring the cephalic vein, a small portion of the deltoid muscle being detached from the clavicle, and the vein drawn outward toward the shoulder. It being now found impossible, from the size of the tumor and its proximity to the coracoid process, to get under the clavicle in this direction, another incision was made from the outer edge of the external jugular vein over the tumor, to the top of the shoulder, so as to divide the skin, platysma-myodes, and a portion of the trapezius, by which means a sound part of the bone was laid bare near the acromion process. A director, very much curved, was then cautiously passed under the bone from above, great care being taken to keep the end of the instrument in contact with the under surface, and an eyed probe being conveyed along the director, a chain-saw was passed, and, after being carefully moved a little to see that nothing intervened, made to cut the bone entirely through at this point.

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* Gross, History of Kentucky Surgery, p. 180.

The dissection being now continued along the under surface of the tumor below the pectoralis major, a number of very large arteries and veins were cut and ligated; the first rib exposed under the sternal end of the clavicle; the costo-clavicular ligament divided and the sterno-clavicular articulation opened from below, thus giving considerable mobility to the mass. The sawed end of the clavicle being then elevated by means of strong curved spatulæ, the subclavius muscle was divided at its origin, the remainder of it being obliterated in the tumor. The tumor was now separated from the areolar and fatty structure between the omo-hyoid and the subclavian vessels, at the upper and outer part of which a number of large arteries required the ligature, especially a large branch from the inferior thyroid artery. The anterior part of the upper incision being then made from the sternal end of the clavicle over the tumor until it met the other at the external jugular vein, this vein was tied with two ligatures, and divided between them. The clavicular origin of the sterno-cleido-mastoid was also divided about three inches above the clavicle, and, the deep fascia being exposed, the mass was very cautiously dissected until the scalenus anticus was exposed; the subclavian vein, which was firmly adherent to the tumor, being most carefully detached, without injury, by the handle and blade of the scalpel. The external jugular vein being so connected with this part of the tumor as to require the application of two ligatures near the subclavian, and its division in the interspace, the whole mass was removed, the hemorrhage throughout being so free as to require more than forty ligatures, and the operation having occupied nearly four hours for its execution. The patient recovered in about eight weeks, and was subsequently enabled to use his arm by means of a mechanical contrivance which kept the shoulder off from the chest.*

Operation of J. C. Warren, of Boston.†—A man, aged twenty-four, after violent muscular effort, felt a severe pain at the junction of the right clavicle with the sternum. A year afterward, his clavicle presented a tumor measuring seven inches from the sternal end, in a line with the bone, to its scapular extremity; from the clavicle to the nipple it measured five inches; the tumor being hard, with no evident fluctuation, though a slight pulsation could be perceived by the stethoscope. There was no sensible difference in the pulsation at the wrists; the patient complained of its occasionally pressing on his windpipe, and the constitution presented signs of the scrofulous diathesis.

Operation.—The patient being placed on the table, with the shoulders elevated, an incision was made from the acromial extremity of the clavicle to the sternal end of the opposite bone. This being crossed by another, at right angles with it, beginning just below the middle of the sterno-mastoid muscle, and extending to the face of the pectoral muscle, beneath the middle of the clavicle, the four flaps were dissected from the surface of the tumor, and the outer extremity of the bone laid bare by dissecting the deltoid from its anterior, and the trapezius from its posterior edge. The coraco-clavicular ligament being then divided, an eyed-probe, armed with a ligature, was passed under the clavicle, and a chain-saw attached to the ligature drawn after it under the bone, so as to saw it entirely through.

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* American Journ. Med. Sciences, vol. iii. p. 100, 1828.

† Ibid., vol xiii. p. 17, 1833.

A strong band being now passed around the outer extremity of the divided bone, the tumor was partly moved by it so as to give tension to the surrounding soft parts, Plate XXXVII. Fig. 6.

The pectoralis major muscle, being then divided and dissected from the lower edge of the tumor, was drawn so as to expose the pectoralis minor and the cephalic vein. On continuing the dissection under the tumor, the subclavius muscle could be freed from the outer part, but was lost in the tumor at its sternal end, where the dissection necessarily proceeded over the surface of the subclavian vein. An adhesion of the tumor to the second rib, in which it was imbedded, prevented also its perfect separation at this part until the close of the operation.

The next step being to divide the attachments of the upper or cervical edge of the tumor, the posterior external jugular vein was divided and tied. Being filled with dense lymph, it discharged no blood.

The sterno-mastoid muscle was next cut across, and the sheath of the cerebral blood-vessels exposed, the internal jugular vein, which passed into the tumor, being, after much care, separated from it, and the carotid and par vagum drawn to one side. The anterior external jugular vein was found imbedded in the internal extremity of the tumor, and, though also filled with lymph, was tied, as a measure of safety, when the sternal end of the tumor was, with great caution, separated from the corresponding parts of the jugular and subclavian veins, the whole extent of the latter vessel, as well as the lower part of the internal jugular and par vagum nerve, being exposed and put in motion by the pulsation of the subclavian, carotid, and innominata arteries, when the extirpation was completed. But little blood was lost; only one or two arteries, and the veins just stated, requiring the ligature. The flaps were then brought over and retained by three sutures and adhesive plaster, so as to cover the wound perfectly. On the thirteenth day after the operation, the patient was attacked with chills, and in the fourth week he died—as far as could be judged from the *post-mortem* examination—of constitutional irritation, being of a bad habit of body.

Operation of A. J. Wedderburn, of New Orleans.—A man, aged twenty-one years, was admitted, January 21, 1852, into the Charity Hospital at New Orleans, with caries of the clavicle, so extensive as to require the entire removal of the bone by disarticulating it at its two extremities.

Operation.—An incision being made in the integuments over the entire length of the clavicle, and sufficiently far beyond its extremities to permit the disarticulation, the soft parts over the superior and anterior borders of the bone were dissected off. The clavicle being now disarticulated at its acromial end, the dissection was continued on the under surface by keeping close to the bone, the adjacent structure being kept tense by elevating the clavicle from its scapular toward its sternal articulation. During this, the bone, owing to its being carious, broke in two at about one inch and a half from its sternal end, thus rendering the disarticulation at the sterno-clavicular articulation more tedious than it would have been if there had remained sufficient length of bone to have afforded a purchase. It was, however, safely accomplished.

After-Treatment.—After cleansing the wound, the cavity left by the removal of the bone was filled with lint, saturated with a solution of sulphate of quinia, in order to guard against erysipelas, which was then in the hospital, and the parts kept in this condition for twenty-four hours. The next day, the lint being removed, the wound was united with adhesive plaster, over which was placed a compress of lint, also wet with a solution of the quinia, five grains to the ounce of water. No other treatment was resorted to. The shock from the operation was so slight that the patient sat up within twenty-four hours after its performance, and on the 8th of April he was discharged, without any deformity, and with the perfect use of the arm.*

Remarks.—In the details of these operations, there may be noted some difference in the methods of operating, caused apparently by the peculiar circumstances of each disease, though in most of the important points they correspond. As such will doubtless be the case hereafter, should the operation be again repeated, any estimate of the advantages of one plan over the other could only be theoretical, and not serve as a guide for future operators. In reviewing the accounts just given of these operations, it must be apparent that they create a great risk of life; but this a competent surgeon will doubtless always be prepared to meet, and if the patient's condition can be benefited by a repetition of these rare resections, no experienced operator should for a moment hesitate about their performance. A point worthy of being mentioned, in connection with these operations as well as others involving the great veins of the neck, is the liability to the entrance of air into the large veins from even a very slight wound of the vessel; and when the constant action of the vessel, as affected by the expiration and inspiration of the patient, is recalled, the rapid passage of a bubble of air to the heart may be readily understood. But though this circumstance has caused most speedy death, yet it has not invariably done so, and the use of anæsthetic agents, when judiciously conducted, will, it is thought, greatly diminish this danger. When a patient is fully etherized, marked tranquillity is obtained in the respiratory movement of the chest, and there is, therefore, less risk of a wound being accidentally inflicted; while, in consequence of the diminished inflation of the lungs, absence of all efforts at crying, and also of shock to the system induced by this valuable agent, the risks of the operation, when thus performed, must be less than they were formerly. With the heart beating about sixty in the minute, and the respiration slow and comparatively feeble, as is usually the case in etherization, it may be doubted whether these large veins would not be as free from danger as is possible in any dissection in the neighborhood of their parietes.

§ 2.—Resection of a Portion of the Clavicle.

Resection of a portion of the clavicle is an operation that may be occasionally demanded in cases of necrosis of this bone. It may be performed either at its sternal or humeral third, and is illustrated by the operations hereafter described.

Resection of the Humeral end of the Clavicle.—In a case of necrosis of the clavicle, Velpeau operated in the following manner:—

Operation of Velpeau.—A crucial incision being made with each branch four inches long, the flaps were dissected back, the acromio-clavicular ligament and some portions of the deltoid and trapezius muscles divided, and the necrosed bone raised by means of a bit of wood which was employed as a lever, until the sequestrum could be detached from the sound parts.†

Resection of the Sternal end of the Clavicle.—The resection of this end of the bone was performed by Davy, of Bungay, England, in order to relieve the pressure upon the œsophagus of a young lady, consequent on a dislocation of this extremity of the clavicle by a disease of the vertebral column.

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* New Orleans Monthly Medical Register, vol. ii. p. 1, 1852.

† Malgaigne, Philadelphia edit. p. 195.

Operation of Davy, of England.—An incision, two inches long, and following the axis of the clavicle, being made on the extremity of the displaced bone, the articular ligaments were divided, and a piece of shoe-leather slipped under the end of the bone, so that it could be divided by sawing upon the leather without involving the deeper-seated parts. The wound healed readily, deglutition was restored, and the patient perfectly relieved by the operation.*

SECTION III.

RESECTION OF THE SCAPULA.

Resection of the Scapula has been performed, in several instances, for the removal of large tumors, either so as to leave the neck and glenoid cavity of the bone, with the exception of its neck, or so as to retain all the portion above its spine.

§ 1.—Resection of the Entire Body of the Scapula.

Operation of Gross, of Louisville, (now of Philadelphia.)† — A tumor, fifteen inches in its vertical diameter, and fifteen and a half inches in the transverse, having been developed on the scapula, so as to impair the use of the arm and cause great pain in the limb, it was removed with the scapula in the following manner:—

A full dose of chloroform having been administered, an incision, sixteen inches long, was made obliquely downward and inward from the superior angle of the scapula to the inferior portion of the tumor. Another, which began about five inches below the upper end of the first, was then carried in a curvilinear direction, so as to terminate about the same distance from its lower end, and, the dense integuments being dissected off, first toward the spine, and then toward the axilla, the levator scapulæ and trapezius muscles were divided. The acromion process being then sawed through just behind the clavicle, the latissimus dorsi and serratus anticus muscles were divided, so that the fingers could be carried underneath; the tumor was elevated so as to sever the connections which existed near the ribs, and the deltoid and other muscles of the arm being next incised, the neck of the scapula was sawn through, and the entire mass removed with comparatively little difficulty. About twenty-four ounces of blood were lost, several arteries near the neck of the bone requiring the ligature after the removal of the morbid growth. The immense wound being now united by sutures and adhesive strips, the parts were supported by a compress and broad body bandage, and nearly the entire wound healed by the first intention. At the end of three weeks the patient returned home, but, having taken cold on the journey, was attacked by pleuro-pneumonia, which was followed by hectic fever, under which he sank in two months.

Operation of Hayman.‡—A large tumor, which was attached to the scapula, was laid bare by two semicircular cuts through the skin and tendinous expansion, and cut away by rapid strokes of the knife, when the bone was sawn obliquely through its spine, so as to leave only the glenoid cavity and the parts immediately above the spine. This patient recovered, and could move the arm in most directions, except in elevation.

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* Malgaigne, p. 196.

† West. Journ. Med. and Surg., vol. xi. 3d series, p. 420.

‡ Chelius, Syst. Surgery, vol. ii. p. 762.

Operation of Luke, of England.—An incision being made through the skin, from the axilla along the axillary margin of the tumor and anterior costa of the bone, and round the inferior angle to within a short distance of the spine of the scapula, a second incision was carried along the lower margin of the spine, from the commencement of the first to its termination. The muscles in the supra and infra-spinata fossa being then incised in a direction from a little behind the glenoid cavity to a little above the superior angle, the scapula was steadied and the bone sawed through near the root of the acromion process, when the whole structure was removed. The hemorrhage was very free, twenty or thirty arteries near the armpit requiring the ligature, and about a pint or a pint and a half of blood was lost. The edges of the wound being then closed by adhesive strips, the arm was secured to the side by a bandage, and the forearm placed in a sling. In two months the wound had completely healed, and in eleven months after the operation the motion of the arm, forward and backward, was perfect, and, in fact, greater than usual, the limb moving with more than the ordinary pliancy, and also possessing considerable power. Rotation outward and inward was possible, and the patient had sufficient strength to lift with ease moderate weights, though elevation of the arm from the side could only be accomplished by the aid of the opposite hand.

Remarks.—The resections of considerable portions of the body of the scapula have also been performed by Liston, Janson, Syme, Wurtzer, Textor, and Travers, in Europe,* and are evidences of the progress of operative surgery in a department which has for its special object the preservation, to a certain extent, of the usefulness of the limb. With the exception of some variety in the external incisions required by the development of the tumors which demanded the resection, these operations have all had some general points of resemblance, the preservation of the glenoid cavity being the great object of all of them, in order that the mobility of the limb might be retained. Among American surgeons, the most marked case is that of Gross, though excisions of the scapula, and even of the scapula and clavicle, have been performed by other surgeons in the United States, either in the act of amputating at the shoulder or in consequence of the development of disease in this region after amputations. As these latter operations are, however, properly amputations of the shoulder-bones, they will be referred to in connection with amputations of the upper extremity, in a subsequent portion of this volume.

§ 2.—Resection of the Acromion Process of the Scapula.

The resection of the **Acromion process** of the scapula is an operation so very similar to that of the acromial end of the clavicle, allowance being made for the position of the muscles as well as for the greater facility of access to the part, that it can be readily understood without further reference.

The resection of the **Inferior angle of the scapula** would require the employment of such incisions as would freely expose the part, after which its removal could be accomplished by bone nippers or strong scissors passed beneath the bone.

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* Chelius, vol. iii. p. 763.

SECTION IV.

OPERATIONS ON THE PARTS ABOUT THE CLAVICLE.

In the portion of the chest immediately about the clavicle only one operation of importance is ever requisite, to wit, the ligation of the **Axillary Artery**, or, as it is sometimes though incorrectly termed, the ligation of the subclavian artery beneath the clavicle.

§ 1.—Ligation of the Axillary Artery beneath the Clavicle.

The **Axillary artery** in this portion of its course may be found in the triangular space which is bounded above by the clavicle, below and on the outside by the pectoralis minor muscle, and below and on the inside by the sternal origin of the pectoralis major.

Ordinary Operation.[*]—The patient being laid upon the table, with the shoulders slightly raised, and the elbow carried a little off from the body, so as to stretch the skin, an incision should be made three inches long, and about three-quarters of an inch below the clavicle, parallel with the bone, so as to terminate outside of the line of junction of the pectoralis major and deltoid muscles, dividing only the skin. The superficial fascia of the chest and the fibres of the pectoralis muscle being then carefully cut, and attention given to the position of the cephalic vein, a director should be introduced beneath the posterior portion of the sheath of the muscle; then, after bringing the arm to the side, so as to relax the parts, tear the connective tissue about the vessels with the point of the director, and carry the index finger behind the upper border of the pectoralis minor muscle, and, pushing it downward and outward, the vessels will be seen in the following order: 1st. On the inside, the axillary vein swollen at each expiration, and partially covering the artery. 2d. Outside, and a little behind the vein, the axillary artery. 3d. More externally and behind, the nerves of the brachial plexus. The vein being drawn inward by a blunt hook, the aneurismal needle should be passed between the vein and the artery from within outward, above the origin of the acromial and mammary arteries, which would otherwise interfere with the formation of the coagulum, Plate XXXVI. Fig. 4.

Operation of Lisfranc.—Abducting the arm forcibly from the body, so as to render distinct the clavicular and thoracic origins of the pectoralis major muscle, Lisfranc incised the skin in an oblique direction from the clavicle downward and outward. The fascia superficialis being then carefully divided, and the line of separation of these two parts of the muscle apparent, their adhesions were separated by the finger or knife-handle, the arm brought close to the side, and the artery sought for and tied, as in the plan just described. Malgaigne[†] gives as a "rule" a direction which I have always found to be a good one, and that is, after the laceration of the posterior part of the sheath of the pectoralis major muscle, to search on the inside of the wound for the vein, which is the first vessel met with, and is an infallible landmark. Carrying it inward, the artery will be found a little outside and a little behind.

Remarks.—The ligation of the axillary artery by either of the above plans will be found to be a very troublesome operation, and in the case of artery, while its veins run up into the axillary vein. Its removal may be readily effected by incising the skin in such a form as circumstances may demand, but the subsequent dissection of the gland should be conducted in the line of the fibres of the pectoralis muscle, that is, from the sternum toward the axilla.

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[*] Malgaigne, Philad. edit. p. 147.

[†] Ibid., p. 148.

Operation.—The patient being etherized and placed upon a table, rather than upon a chair, with her head and shoulders slightly raised, the arm of the affected side should be carried off from the body, and held by an assistant, so as to keep the skin and pectoral muscle upon the stretch. Then, standing on the side of the disease, or by the shoulders of the patient, place the four fingers of the left hand upon the skin, so as to make it tense, while an assistant does the same with the integuments of the opposite side of the tumor. After thus steadying the skin, make a semi-elliptical incision, with its concavity upward and the nipple near its centre, either by cutting from the axillary margin of the gland, or lower portion of the anterior border of the axilla toward the sternum, if standing on the diseased side, or by beginning on the sternal side and extending the cut toward the axilla if standing at the shoulder of the affected side, holding the scalpel in the first position, Plate II. Fig. 1,* and bearing on it with tolerable firmness, so as to divide the integuments thoroughly by the first stroke of the knife. Then, while the breast and skin are drawn in different directions, dissect the integuments free from the gland on its lower portion, and make another elliptical incision, with its concavity downward, on the upper side of the gland, so as to meet the first one at its sternal termination, but not quite reach it at the axilla, including between these two incisions as much integument as will remove any excess of skin, Plate XXXVIII. Fig. 1. Then, dissecting the upper flap off from the gland in the same manner as before, seize the mass firmly, either with the tumor forceps, or by means of a ligature passed through it, or by the fingers, which are usually the best instruments, and dissect it from the sternum toward the axilla, either by working from above downward or the reverse, according as it is found most convenient, though the dissection from below exposes the operator to the risk of getting beneath the fold of the pectoral muscle in approaching the axilla. As the various branches of the mammary arteries (external thoracic) are divided, the hemorrhage, if profuse, or if the patient is feeble, should be checked, by ligating each vessel as it is cut. But if this is not the case, the bleeding may be overlooked for the moment, or temporarily checked by compression of the arteries by the fingers of an assistant, when they will often contract and give no further trouble.

In prosecuting this dissection, the left forefinger and thumb should constantly examine the surrounding textures, in order to detect any hardened portions, the dissection being always carried so far into the healthy tissue as to leave a margin of the latter to be extirpated along with the breast. On approaching the axillary end of the ellipse, grasp the breast in the left hand, Plate XXXVIII. Fig. 2, and draw upon it so as to insure the removal of any of the condensed laminæ or fibres of indurated connective tissue which are connected with it. If the axillary glands also show any signs of hardening, they may now be readily removed, by slightly prolonging the incisions into the axilla, and working from above downward; but this part of the operation requires considerable care, in some instances, in order to avoid injuring the axillary vein. To prevent this, it will be found advantageous not to elevate the patient's arm to any great extent, as this position rather puts the axillary vessels on the stretch, and brings them near to the point of the knife. When any of the thoracic veins appear to be connected with the lym-

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* Vol. i. p. 184.

PLATE XXXVIII.

OPERATIONS PRACTICED ON THE CHEST.

Fig. 1. Extirpation of the mammary gland of the female. The patient is seen lying down with the arm carried off from the body, and the lowest of the two elliptical incisions has been made from the axilla toward the sternum. The parts being intended to heal by granulation, much more of the integument is about to be removed than is usual in the United States. 1, 2, 3. First or lowest incision. 1, 4, 5. Line of second incision. *After Bernard and Huette.*

Fig. 2. Represents the completion of the operation of extirpation of the breast as usually practiced. The left hand of the surgeon grasps the gland and draws it toward the sternum, while the thickened connective tissue or lymphatics are being dissected from the margin of the axilla. *After Nature.*

Fig. 3. A view of the arrangement of the adhesive straps after the operation These straps should be long, and pass obliquely around the chest, so as to leave intervals between the different pieces. A mesh of linen has been introduced between the edges of the skin at the lowest angle of the wound, in order to secure a vent for the matter. 1. Line of union of the wound left by the incisions. 2. Mesh to favor escape of the pus. 2, 3. Posterior course of the adhesive straps. *After Bernard and Huette.*

Fig. 4. Operation of empyema upon the right side of a man. The patient is represented lying down, and slightly inclined to the left side, while the surgeon makes an opening between the eighth and ninth ribs. *After Bernard and Huette.*

Fig. 5. Resection of two of the ribs on the left side. The patient lying down and inclined toward the right, a crucial incision has been made over the seat of the disease, the flaps, 1, 1, turned back, the ribs, 2, 2, sawed across or broken, and the posterior extremities elevated by a bandage, previous to their removal. The thickened surface of the pleura, 3, is seen behind the seat of the disease. *After Nature.*

Plate 38.

Fig. 1.

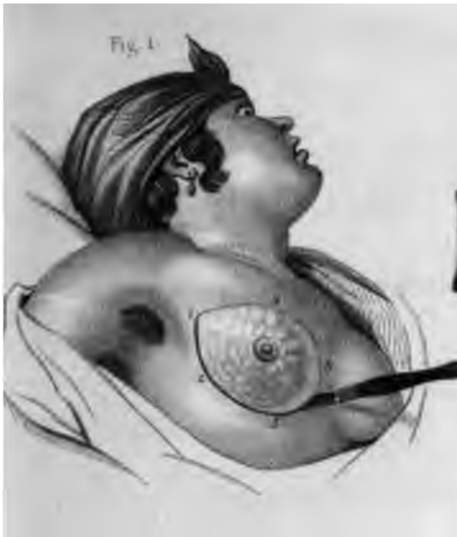


Fig. 2

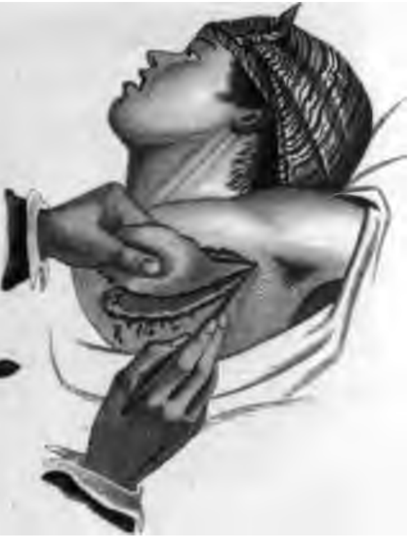


Fig. 3.

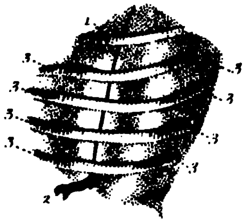


Fig. 4.

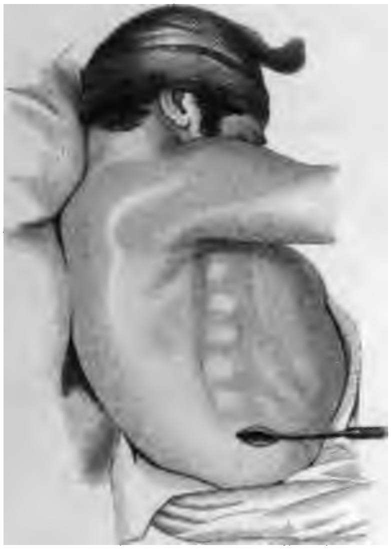
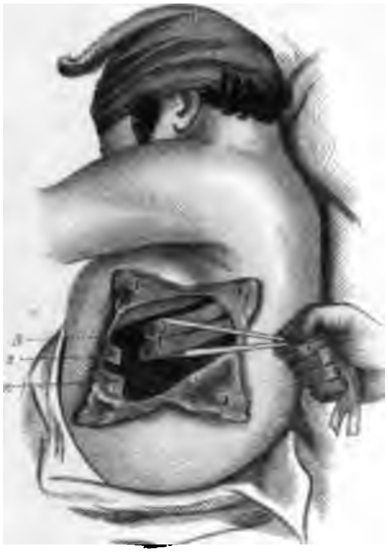


Fig. 5.



phatic glands or indurated tissues, or when the disease is thought to approach near to the main vein, it will be safer, instead of dissecting it out, to surround the axillary portion of the structure with a strong ligature, and cut off the part connected with the tumor on the mammary side of the thread, leaving the remainder to slough or ulcerate out.

After being fully satisfied that every diseased particle is removed, the wound should be cleansed, any arteries that continue to bleed ligated, and the ligatures brought out at the sternal extremity of the incisions.

The arm being now brought to the side, the edges of the skin may be approximated and held together at the central point by a single suture, supported by long adhesive strips, or the whole may be closed by the interrupted metallic suture without resorting to the use of the plaster. In either case, it is a good practice to introduce a little mesh of linen into the lower orifice of the incision, Plate XXXVIII. Fig. 3, in order to secure a vent for the pus by preventing the entire union of the skin before the ligatures come away, or before adhesions have formed in the deeper-seated parts. When adhesive strips are employed, they should be applied from below upward, obliquely across the line of the wound, so as to leave spaces between each strip for the escape of matter, Plate XXXVIII. Fig. 3. After this, a compress should be firmly retained against the part by a spiral reversed bandage of the chest, so as to prevent the pus collecting within the lower flap, while the arm of the side operated on should be supported in a sling, or kept close to the side, so as to preserve perfect rest of the pectoral muscle until union has occurred.

If the disease has involved a part of the pectoral muscle, this portion should also be removed, though, as a general rule, it is best to avoid incising even the anterior fascia of the muscle, lest it subsequently interfere with the free motions of the arm. Should the gland be known to be adherent to the muscle before operating, the chances of the cure will be so much diminished that the surgeon may well hesitate before he advises his patient to submit to the knife.

In cases of open or ulcerated cancer, such as are not deemed suitable for an operation, or where the disease returns and creates a painful ulcer in or near the cicatrix, it will prove advantageous to dress it by covering the sore from time to time with the coating formed by the application of the solution of gutta-percha in collodion, as suggested by Dugas, and spoken of under cancer of the lip. In the case reported by Dugas,* there was a cancerous ulceration, of several months' standing, of the size of the areola, in the depressed centre of which were seen the remains of the nipple. The axillary glands were also much enlarged, and the patient a prey to continual pain, which was especially severe at night. Under the application of a coating of the solution of gutta-percha, applied over the whole breast at first every twenty-four hours, and then, as the discharge diminished, once in a week, the patient was gradually relieved of all pain about the breast, and even in the axilla, slept quietly at night, and enjoyed her meals, a change which must have proved highly serviceable in arresting the progress of the disease.

Remarks on Amputation of the Breast.—The simplicity of the operation of extirpating the breast is often such that the detailed account of it just given may by many be deemed unnecessary, and to the man of experience such will doubtless be the case in this as in most other operations; but to others it will, it is thought, prove useful. The frequency of the operation demands also, that those whose experience is limited should, if possible, be made aware of the difficulties which are occasionally met with; while, in an operation for the removal of a growth which is so very liable to return, too much care cannot be taken to excise every portion that is diseased, and this can only be accomplished by following the details of a proceeding similar to that just stated.

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* New Orleans Medical Register, vol. ii. p. 7, 1852.

In what seemed to be a simple case of extirpation of the mammary gland, as performed by Warren, of Boston, everything did well until it became necessary to remove some of the indurated lymphatic glands of the axilla. When the separation of these was nearly effected, "a vein was divided, which gave exit to a small quantity of venous blood, when almost instantly the patient struggled, her complexion changed to a livid color, and a bubbling, gurgling noise was indistinctly heard, showing the entrance of air into the vein. The axilla was, therefore, instantly compressed, but the patient became insensible, and breathed as if in apoplexy. The tumor was at once separated, the patient laid down, brandy poured down her throat, and the vapor of ammonia introduced into her nostrils, but the pulse became less distinct every instant," and although every other possible means of exciting animation were tried, even to opening the larynx and inflating the lungs by a pair of bellows, and continued without intermission for twenty minutes, the patient never breathed again. In the history of this case, Warren* suggests that the entrance of air into the axillary vein, in this operation, may be prevented by keeping the arm toward the side, so as to relax the coats of the vessel, instead of extending them, as is done when the arm is elevated during the progress of the dissection toward the axilla. But when the surgeon is aware of the risk of this accident, and is cautious, he will be better enabled to see the parts that he is about to cut, when the axillary dissection is made with the arm slightly elevated. In all such cases it is, however, the safest plan to secure the chain of glands and cellular tissue with a ligature, and leave the pedicle to slough out, instead of dissecting into the axilla, in order to remove them.

The selection of the different external incisions, or their direction, is, it is thought, a matter that must be settled at the moment, by the peculiar circumstances of the case. The elliptical incision in the line of the fibres of the pectoral muscle is that most frequently resorted to, and answers perfectly well in most instances. The propriety of arresting the hemorrhage as the arteries are divided, or simply twisting or compressing them during the operation, is also a point on which surgeons differ, and must be left to the decision of the operator, who should be guided in his course by the strength of the patient, and by the number and size of the vessels that are divided. I have seen many instances where only from one to four ligatures were demanded, while, on the other hand, I have been compelled to apply fifteen or twenty before the bleeding was checked.

Statistics.—A very important question connected with this operation is the advantages likely to result to the patient from its performance. To decide this point correctly, it is essential that the subsequent history of the cases operated on should be known, and this, from various causes, it seems to be almost impossible to obtain. In order to gain reliable statistics of the results of surgical operations for malignant diseases generally, the American Medical Association recently referred this subject to a committee, of which S. D. Gross was chairman. This gentleman accordingly furnished† a very elaborate and full report, embracing the opinions of surgeons in every section of the globe, and containing a large amount of valuable details. As the extent of this paper requires that it should be consulted in its unity, I can only express my opinion of its value, and add as illustrative of its results, the following brief synopsis of some of the conclusions at which it arrived :—

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* Warren on Tumors, p. 260; also, Am. Cyclopedia Pract. Med. and Surg., by Hays, vol. i. p. 263, article Air, 1834.

† Transactions American Medical Association, vol. vi. p. 155.

"1st. Cancerous affections, particularly those of the mammary gland, have always, with a few rare exceptions, been regarded by practitioners as incurable by the knife and escharotics.

"2d. That excision, however early and thoroughly executed, is nearly always, in genuine cancer, followed by a relapse, at a period varying from a few weeks to several months from the time of the operation.

"3d. That the profession have always been, and still are averse to any operation for the removal of cancer after it has ulcerated, contracted adhesions, etc., because it then almost invariably returns and progresses more rapidly than when allowed to pursue its own course.

"4th. That extirpation is improper in acute or rapidly developing cancer.

"5th. That all operations for encephaloid growths are more rapidly followed by relapses than those performed in hard cancer.

* * * * *

"14th. That life has occasionally been prolonged, and even saved, by an operation after a relapse; but that, as a general rule, the second operation is as incompetent to effect a permanent cure as the first."

The following points are considered by Gross as unsettled, opinions being divided in respect to them

"1st. The propriety of excision is doubtful in cases which are of hereditary origin.

"2d. It is doubtful whether a very young patient should be operated on, if the disease is of rapid growth, as the operation will only expedite the fatal issue.

"3d. It is doubtful if a case attended by suppression or irregularity of the menses should be operated on.

"4th. A quickened state of the pulse, if occasioned by the local irritation, should forbid the operation.

* * * * *

"6th. It is supposed, but not proved, that the excision of carcinomatous tumors only tends to hasten the patient's death.

"7th. It is doubtful whether an operation on a recent cancer is more successful than that on an older one, other things being equal."

Gross, therefore, sums up his report, which is chiefly based on the experience of others, by expressing his individual practice to be to discourage a resort to the knife in all malignant diseases, except those of the skin or the cancroid variety.

Prior to the appearance of this report, the professional opinion of the result of surgical operations was formed from limited accounts, and from the *recollection* of operators, that, in the majority of cases of well-marked cancer, the operation did not cure the patient, though it was supposed to prolong her days; and the latter assertion has always been urged by those who advocated the operation in all cases The prolongation of life is, I think, a doubtful matter, as I have known advanced cases of ulcerated cancer to live months—in one instance three years—under a local antiphlogistic and palliative treatment, combined with the free use of chalybeates, according to the plan directed by Justamond and others.

The following seem to be the opinions of the other surgeons hereafter quoted, so far as I have been able to collect them, and, as they furnish the views of many eminent men, might have been very much augmented if it had seemed desirable. But with the conclusions stated in the paper of Gross, such an enumeration without a digest would have tended to confuse rather than elucidate the subject, and I therefore present them very briefly.

Rhazes,[*] A. D. 924, opposed all operations for cancer, when the tumor was not entirely free from the surrounding parts.

Albucasis,[†] A. D. 1100, strongly doubted the propriety of operating in cancerous tumors, declaring that he never cured or saw cured a single case.

Monro, in England, and Delpech, in France, are believed to have been opposed to the operation. Velpeau,[‡] on the contrary, regards most of the cancerous, encephaloid, or colloid tumors as a primary local complaint, the rest of the system being only involved secondarily. He thinks, therefore, that every case of cancer should be operated on, and operated on as early as possible, without delaying in order to try remedial measures.

Joseph Parrish, of Philadelphia, admits that, after considerable observation and experience, he was much discouraged by the final success of the operation, and never resorted to the knife—unless at the particular request of the patient—where the disease had penetrated into the axilla, or fixed upon the parts beneath the breast. When the breast alone was affected, he advised the operation, though believing it to offer but a doubtful prospect of escape.

Warren,[§] of Boston, is satisfied that many cases may be cured by the operation, and, according to the best of his information, thinks that one in three has been cured without a relapse, and that when the tumor is not ulcerated, and there are no signs of a constitutional disorder, it is best to try the experiment.

Dudley,[‖] of Lexington, reports to the Committee on Surgery, of the American Medical Association, for 1850, "that he never removed a scirrhous breast without a return of the disease at a subsequent period."

Paul F. Eve[¶] "never operated when the diagnosis was unequivocal, that the affection did not return."

J. Kearny Rodgers,[**] of New York, gives, as the result of his experience, that "no two cases survived the operation, in good health, two years; the majority being in their graves in less than twelve, and many in six months."

Mussey,[††] of Cincinnati, who was the chairman of the committee of the American Medical Association, on these statistics in 1850, in speaking of his own experience, says that he "has operated for cancer of the breast, in many instances, without learning the sequel; but of those ascertained there were only two in which the disease did not return in some part of the system within four years, and most of them within one year."

Twitchell,[‡‡] of New Hampshire, entertained the same views; so also did Knight, of Connecticut; but the latter thought that in some instances life has been prolonged by the operation.

Flint[§§] has seen one case of undoubted encephaloid disease of the breast, in which the patient was well seven years after the operation.

The result of Mussey's report is, therefore, "that soft as well as hard cancer of the mammary gland is, in some instances, a local disease, and that the operation *may* prolong life."[‖‖]

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[*] General History of Surgery, p. 35, vol. i. of this work.

[†] Ibid., p. 35.

[‡] Dict. de Med., tome xix, p. 97.

[§] On Tumors, p. 278, 1839.

[‖] North Am Med. and Surg. Journ., vol. vi. p. 300, 1828.

[¶] Transactions American Medical Association, vol. iii. p 332.

[**] Ibid.

[††] Chairman of committee, op. cit.

[‡‡] Trans. Am. Med. Association, vol. iii. p. 332.

[§§] Opus cit., p. 334.

[‖‖] Opus cit., p. 337.

Gross in his late report to the American Medical Association,[*] just referred to, also expresses the opinion, as based upon the views of surgeons in every section, that it is improper to operate in any case when the disease is *hereditary*, as such cases are peculiarly virulent and intractable, and tend rapidly to a fatal termination.

Leroy D'Etiolles[†] gives, as the result of his statistics, that, in four hundred and twelve cases, the mean result of cancer in women—not limiting the disease to the breast—was three years and six months life, without the operation, and two years and six months after it. "Extirpation of cancer does not, therefore, prolong life." Of cancerous tumors in the breast alone, Leroy gives the following result: "Of two hundred and four, twenty-two died in the year after the operation, and eighty-seven had a return of the complaint, making the whole number one hundred and nine, or more than one-half." He, therefore, discountenances the operation.

Broca,[‡] in a prize essay on the pathological anatomy of cancer, has added other melancholy illustrations of the subsequent position of patients who have been operated on for cancer. In this essay he shows, that of 39 really cancerous patients—the tumors having been examined microscopically—11 died from the consequences of the operation, and 28 survived these. Of 19 of the latter who were kept in view, every one relapsed; 16 dying within the first twelve months after the operation; 2 in the course of the second year; and 1 at the end of the 25th month.

"Sir Benjamin Brodie[§] also states that the elder Cline and Sir Everard Home would scarcely ever consent to the operation under any circumstances."

"Bransby Cooper gives, as his recollection of the sentiments of Sir Astley, that he acknowledged there were only nine or ten out of a hundred extirpations that he had performed in which the disease did not return."

The same surgeon, however, reports one of his own cases where it was eleven and a half years before the disease showed itself; and Callaway, a case where the patient did not die till twenty years subsequent to the operation.[‖]

My own observation, though limited in comparison with the experience of the distinguished men just named, is decidedly adverse to the *cure* of cancer of the breast by an operation, not one out of ten, to the best of my knowledge, having escaped a return of the disease.

In analyzing the opinions last quoted, it seems that nearly four are opposed to the operation for every one who favors it, though, even among those quoted as favoring it, the recommendation is only either as an experiment, or in the hope of prolonging life.

Under the statement exhibited in the present statistics, I think a surgeon had, therefore, better state to his patient the little danger that is to be apprehended from the performance of the operation, but also state the chances of a return of the complaint, indicating the temporary relief obtainable by an operation.

Paget, in summing up the evidence in connection with the question—"Whether it is probable that the operation will add to the length or comfort of life enough to justify the incurring this risk (loss of life) from its own consequences, says:[¶] "I cannot doubt that the answer may be often affirmative. 1. In cases of acute hard cancer the operation may be rightly performed, its performance being justified by the probability that it will in some measure prolong life, and save the patient from dreadful suffering. 2. On similar grounds the operation seems proper in all cases in which it is clear that the local disease is destroying life by pain, profuse discharge, or mental anguish, and is not accompanied by such evidence of cachexia as would make the operation extremely hazardous."

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[*] Trans. Am. Med. Association, vol. vi. p. 174, 1853.

[†] Chelius's Surgery, vol. iii. p. 510, note by J. F. South.

[‡] Brit. and Foreign Med.-Chirurg. Rev. and Charleston Med. and Surg. Journ., vol. viii. p. 413, 1853.

[§] Chelius's Surgery, vol. iii. p. 539.

[‖] Ibid., p. 540, note by J. F. South.

[¶] Op. cit., p. 528. Philad. edit.

SECTION II.

REMOVAL OF TUMORS OF THE CHEST.

In addition to the tumors just referred to in connection with the mammary gland of the female, the surgeon may be called upon to extirpate degenerations of the same gland or its resemblance as found in the male. This, as well as the ordinary lipomatous, fibrous, or other tumors found upon the side of the chest, may be readily excised by the means described in connection with the treatment of tumors in the neck, that is, by making an elliptical, crucial, or other suitable incision through the skin over the tumor, introducing the loop of a ligature into it, in order to obtain a firm hold upon the growth, and then dissecting it, with as little injury as possible, from the surrounding parts. The after-treatment should be the same as that described in connection with the operation on the female mamma.

When the tumor is a cyst with liquid contents, it may be cured by means of the seton, according to the usual plan.

The following case may serve as an illustration of the character and means of treatment occasionally useful in these tumors.

§ 1.—Congenital Encysted Tumor on the Right Side of the Chest successfully treated by a Seton.

An infant, three weeks old, of good development and health, had a tumor, at birth, of a globular shape, six inches in its vertical diameter by seven and a quarter in the transverse. Its circumference at the base was thirteen inches, and it reached from within an inch and a half of the sternum in front, to the spine behind, and from the axilla, as low as the tenth rib. It was soft, elastic, fluctuating, and transparent, like a hydrocele. Its surface was somewhat lobulated, of a bluish color, and traversed by large veins, the skin being sound, and the part free from pain.

Operation of Gross, of Kentucky.*—After ascertaining, by an exploratory puncture with a cataract needle, that the contents of the tumor were liquid, a small trocar was introduced, and seven ounces of serum, colored like Madeira wine, were drawn off, leaving about one-third of the contents in the tumor. The puncture was then closed by adhesive plaster. Three days subsequently, six ounces of liquid were evacuated in the same manner, emptying the sac entirely; after which the collapsed walls were approximated by a compress and bandage. Four days subsequently there was a partial reaccumulation, which was drawn off, and a few silk threads introduced to act as a seton, as in the treatment of hydrocele. At the end of forty-eight hours, sufficient inflammatory action being excited, the seton was withdrawn, and the patient, after a convulsion and serious constitutional disturbance, recovered.

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* Am. Journ. Med. Sciences, vol. xvii. N. S. p. 22, 1846.

CHAPTER XII.

OPERATIONS PRACTICED ON THE WALLS OF THE THORAX.

Owing to the existence of caries, necrosis, exostosis, or other diseases of the bones of the thorax, or from the formation of matter within the cavity of the chest, it has occasionally been found necessary to resort to such operative measures as will facilitate the removal either of the affected ribs, or of the liquid that may have accumulated within the pleura, so as to interfere seriously with the action of the lung.

SECTION I.

SURGICAL ANATOMY OF THE THORAX.

The parietes of the **Thorax** have been subdivided into the anterior, posterior, and lateral portions, to the latter of which the surgeon is chiefly limited in the operations about to be described. The greatest portion of the thorax being formed of the ribs, and parts immediately connected with them, that part of the chest which is bounded by these bones has been named the **Costal Region.**

This region presents two faces: the one which is concave, smooth, and lined by the pleura, being designated as the pulmonary surface; while the other, which is external and convex, is only covered by the integuments and muscles.

The muscles of the Chest are found both between the ribs as well as exterior to them, and are mainly concerned either in respiration, or in the motion of the body.

Of these muscles the intercostal fill up each intercostal space, and present their fibres in different directions, those of the outside passing from above downward and from behind forward, and those which are within, taking the opposite line.

On the outside of the lateral portion of the chest, we find the serratus magnus muscle, which, arising from the nine upper ribs, is inserted into the base of the scapula. At the same part, there may also be noted some of the digitations of the external oblique muscle of the abdomen; which, arising from the eight inferior ribs, are interlocked in its five upper heads with the serratus magnus. The diaphragm, after being attached to the lower edge of the thorax, rises up within the chest by a convex surface, which is on a level with the fourth rib.

The Intercostal Arteries pass from behind forward, and are found on the lower margin of each rib between the two intercostal muscles from the third rib down.

The Veins and Nerves follow pretty much the course of the arteries, and all of these parts, as well as the inner surface of the bones, are lined by the serous membrane known as the Pleura Costalis. The adhesions of this membrane to the ribs is often exceedingly firm, especially when diseased, though at other periods it has been found to be much thickened, and yet quite distant from the ribs, in consequence of the formation of exterior abscesses depressing it upon the pulmonary cavity.

SECTION II.

OPERATIONS ON THE CHEST.

Resection of one or more of the ribs, or perforation of the sternum, or the extraction of liquid from within the cavity of the pleura or pericardium, are the principal operations to which attention may now be given.

§ 1.—Resection of the Ribs.

Resection of the Ribs has been demanded in cases of serious diseases of these bones.

In a patient of George M'Clellan,* a spina ventosa was developed upon the sixth and seventh ribs of the right side, which extended from their cartilages nearly to the dorsal vertebræ, so as to form a tumor not less than ten inches in its longest diameter. This tumor projected four inches on both the internal and external surface of the ribs, so as to push back the pleura, and nearly destroy the function of the lung.

Operation of M'Clellan, of Philadelphia.—By two elliptical incisions, which included a portion of the skin, the integuments over the tumor were removed from around this point, and the sixth and seventh ribs found to be so involved in the disease as to have caused the destruction of most of their central portions, their extremities projecting at either side into the substance of the tumor. On removing the mass, by means of the chain-saw and bone nippers, the hand could be readily passed within and behind the ribs, so that the soft pulpy contents of the tumor, mingled with the expanded and bony fragments, could be rapidly scooped out, the remainder being carefully detached from the pleura by the fingers and handle of the scalpel until the whole mass was removed. The hemorrhage, which was free, was then checked by lint, slightly moistened with creosote.

The cavity left by the disease was now seen to be quite large, being capable, without exaggeration, of admitting with ease a child's head of the ordinary size at birth.

The patient, immediately after the operation, did well; the wound filled rapidly with granulations, and the lung gradually recovered its function, the patient being sufficiently recovered to dress and walk about his room, when an attack of bilious remittent fever caused death ten weeks after the operation.

A remarkable case of resection of the fifth and sixth ribs, performed by Antony, of Georgia, may also be found by reference to the Bibliographical Index.

In the systematic description of resection of these bones, usually presented in the various works on operative surgery, the following directions are given:—

Operation.—Lay bare the diseased portions of the bone either by a straight, curved, or crucial incision, Plate XXXVIII. Fig. 5. Divide the intercostal muscles above and below the rib, either from without inward, or the reverse, on a director passed under them. Then detach the pleura from the rib with the handle of a scalpel, and saw through the bone with a chain or Hey's saw. The pleura being usually thickened, there is but little danger of wounding it, though occasionally this membrane is almost healthy.

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* M'Clellan's Princ. and Pract. of Surg., note by J. H. B. M'Clellan.

Remarks.—The comparative rarity of a disease which could create such effects as would lead a surgeon to think of the resection of the ribs, as well as the risk of injuring the pleura, has rendered this operation not only uncommon, but also one from which many surgeons would at first recoil, as not being likely to benefit the patient. But this is not by any means a modern operation, nor are such cases unique as that reported by Antony, as may be readily seen by a brief reference to the history of the operation. In an article on the Resection of the Ribs, by J. Cloquet and A. Bérard,* and in one by Velpeau,† there may be found a reference to numerous instances in which this operation has been performed, the periods varying from the time of Galen up to the present day. Velpeau mentions a case reported in the ancient *Journal Encyclopêdique*, in which Suif excised two ribs, and removed a portion of the lung in such a manner as to be able to introduce his fist into the chest, and yet the patient recovered. In a case reported by Richerand, in 1818, the middle portions of four ribs were removed to the extent of four inches, and the thickened pleura also excised, so that the pulsations of the heart in the pericardium could be seen. The patient lived several months, but ultimately died of a return of the cancer, for the relief of which the operation was performed. According to Velpeau, Severin, J. L. Petit, Duverney, David, Lapeyronie, and Dessault have all done the same thing in cases of caries and necrosis. He has also performed the operation himself in three instances with success.

Warren, of Boston, also reports having successfully excised the seventh, and in another case the sixth and seventh ribs successfully for caries; and McDowall, of Virginia, Mott, of New York, and M'Clellan, of Pennsylvania, in three other instances, performed this resection with varying success. As an operation, its execution may therefore be said to be comparatively easy, the thickened condition of the pleura obviating most of the risk likely to arise from opening the pulmonary cavity. But it should be remembered that caries and necrosis can both be cured by the mere efforts of nature, or by slight surgical assistance, and nothing can, therefore justify a repetition of any of these operations, unless the sufferings of the patient and the effects upon his respiration should be most urgent. Indeed, in this, as in many other cases, surgical skill and judgment are often best shown when the surgeon can cure the complaint without resorting to the knife.

Caries or Necrosis of the Sternum may usually be relieved, when an operation is demanded, by trephining the bone, this operation being the same in principle as that described in connection with the injuries of the head.

§ 2.—Paracentesis Thoracis, or Thoracentesis.

The evacuation of liquid from the cavity of the chest is among the most ancient of surgical operations, being referred to by Hippocrates, B. C. 460, as well as by many others at different periods subsequently.

Pathology of Liquid Effusions into the Chest.—The word empyema—εν, in, πυον, pus—though originally employed to designate a collection of pus in any cavity, and especially in the chest, is now often incorrectly used to express the presence of any liquid, or even the operation that is required to evacuate it. The operation of paracentesis thoracis being, however, intended especially for the relief of collections of pus within the pleural cavity, or for the removal of the fluid of hydrothorax, a brief reference to the pathological condition of the parts concerned may advantageously be made to precede the description of the operation.

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* Dict. de Médecine, tome ix. p. 147.

† Operat. Surg., by Mott, vol. ii. p. 738.

A collection of pus, either within or without the pleura, is usually the result of such circumstances as induce an inflammatory action of the part, such as external injuries, or pleuritic attacks, or it may be produced by the bursting of large vomica, or from the discharge of abscesses in the liver. When the complaint results from external violence, the purulent collection will often be found to be nothing more than an abscess exterior to the pleura, though the effusion may also ensue upon the development of caries or necrosis of the adjoining ribs, the tumor which indicates the collection being made by pus which comes from within the pleural cavity. In most instances, however, whether of external or internal empyema, the pleura exhibits the ordinary signs of inflammation of the serous tissues, such as opacity, thickening, false membrane or pus, and sometimes adheres to surrounding parts so closely as to create cysts. Occasionally, it has also happened that the pleura has been thickened to the extent of three or five superimposed layers of lymph, exhibiting a honeycomb like arrangement, or a genuine fibrous, cartilaginous, or osseous degeneration. When the effused liquid is in great quantity, and within the pleural cavity, the lung will be found compressed to the top of the chest, though occasionally strong adhesions to the pleura costalis may retain it much lower, and expose it to be wounded in the operation of thoracentesis.

An account of the diagnostic signs of such a condition as would justify the operation would carry these remarks too far, and it must, therefore, suffice merely to state that auscultation and percussion of the chest should be skillfully employed in every instance, before the surgeon attempts the operation.

The operation of thoracentesis has been variously performed, but the object of all the plans is to evacuate the liquid contents of the part, without admitting air into the pulmonary cavity. To accomplish this, it has been suggested to puncture the parietes of the chest with a trocar and canula, or with a trocar and syringe, or to make a direct dissection, layer by layer, from the skin to the pleura. In all the plans that have been recommended for the accomplishment of this object, surgeons have differed mainly in regard to the best point for the puncture; but as the patient is usually compelled to sit up, and as the general anatomical relations of the region especially favor a certain point, it is sufficient to state that, when circumstances admit of it, the space between the fourth and fifth, or fifth and sixth ribs, and a little posterior to their middle, should be selected

In order to avoid wounding the diaphragm, which is presumed to be pushed up by the liver, it is generally advised to puncture the right pleura one rib higher than that advised for the left. Such a position is, however, far from being established as correct, the idea being based rather on the descriptions of the normal condition of the part than on the diseased state, and it is most probable that the weight of the fluid collected within the right pleura will more than counteract any elevation of the liver when the patient is in the erect position. In counting the ribs in a person of moderate flesh, but little difficulty will be found in tracing them from below upward; but in those who are fat, or in those who have the side edematous and swollen, it may be impossible to distinguish these spaces, and under such circumstances the rule has been given to select a spot which is about six finger-breadths below the inferior angle of the scapula,* when, by directing the patient to take as full an inspiration as possible at the moment of puncturing the pleura, the diaphragm will be secure from injury.

Ordinary Operations of Thoracentesis.—The patient being propped up in bed, and a little inclined to the sound side, so as to separate the ribs as much as possible on the diseased side, divide the skin to the extent of one and a half inches in a direction parallel with the superior edge of the lowest rib on the intercostal space that is selected for the puncture. Then, after dividing the superficial fascia, and any portion of a muscle of the chest that may intervene, as well as the external and internal intercostal muscles, the pleura will generally be found to bulge into the wound, and being distinctly felt by the forefinger, so as to establish the fact that only a fluid is behind it, puncture the membrane with the point of a bistoury, and enlarge the opening gradually as the liquid escapes,† Plate XXXVIII. Fig. 4. If the pleura is very much thickened, care will be requisite to avoid the error of pushing it before the instrument, for such a case has been seen.‡ Velpeau entertains the opinion that in cases which require the operation of paracentesis, the effused liquid, or even an abscess, will remove the lung from the point of puncture, and thus secure it from being wounded. He, therefore, objects to the details just given, and advises that the side of the chest be at once opened by a deep puncture with the bistoury in the same manner as an ordinary abscess.

Operation of Metcalfe, of New York.§—The patient being placed in the horizontal position, an exploring needle was passed between the seventh and eighth ribs immediately beneath the angle of the scapula, and the presence of serum rendered positive. A bandage being then passed around the chest, a short incision was made in the skin with a lancet, and the trocar of Schuh passed into the chest to the depth of one inch and a half. The cock of the canula being now turned and serum escaping, a flexible catheter was adjusted to the mouth of the canula, and its free end immersed in a little clean water, the fluid being thus allowed to escape from the chest without the admission of any air into the pleural cavity. In this manner, seventy-two ounces of serum were evacuated, the steady tension of the bandage preventing any discomfort from the evacuation of the fluid. The operation lasted half an hour, and the patient was then able to take a long, full inspiration, and was temporarily relieved, the object of the operation in the present case being only palliative. The instrument employed was a modification of Schuh's instrument, and consisted of a trocar three and a half inches long by about one line in diameter, resembling the ordinary instrument for tapping hydrocele, which was fitted into a canula in which was a cock at the distance of two and a quarter inches from the end which entered the chest. A roughened handle projected at right angles to the axis of the tube at its external extremity. The canula was of the same diameter throughout, and had no cup as in the ordinary canula, so that an elastic catheter could be readily attached to it. Its simplicity over the trough of Schuh is its chief recommendation in the opinion of Metcalfe. In order to tell when the serum from the chest passed out of the end of the catheter which was immersed in the water, a crumb of bread, pressed between the fingers to render it heavy, was dropped near the end of the catheter, and by its motion indicated the current caused by the effused liquid.

After-Treatment.—If circumstances render it desirable to keep the wound

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[*] Malgaigne.

[†] Velpeau, Op. Surg., by Mott, p. 515, vol. iii.

[‡] By Sweet, Amer. Jour. of Med. Sciences, vol. xiii. N. S. p. 518, 1847.

[§] New York Med. Times, vol. ii. p. 377, 1853.

open, a tent may be introduced, and removed from day to day. This tent may be made of fine silver wire threads twisted together so as to form a T, the vertical part of which is to enter the wound,* when the discharge is purulent. But if the whole of the liquid to be evacuated is serum, the opening may be at once closed with adhesive strips, a compress, and bandage. If the subsequent discharge continues copious, or becomes very fetid, advantage may be derived from washing out the cavity with warm water, or warm barley water; weak astringent washes, or those of an antiseptic character, as dilute solutions of the chloride of soda, being subsequently employed. Metcalfe,† of New York, has reported eight cases operated on in the Bellevue Hospital, New York, four of which died, and the result of two appears unknown.

In order to evacuate the liquid, and yet prevent the entrance of air, various contrivances have been employed. Pelletan employed a syringe for this purpose, and Reybard placed a piece of gold-beaters' skin, or the intestine of the cat, over a canula introduced into the pulmonary cavity, by means of a perforation in the rib, so that the matter might flow out and yet the air not enter.

Wyman, of Cambridge, United States, has also invented a brass suction pump with an exploring canula, in order to permit the evacuation of the fluid without allowing the air to enter the pleura, and has reported‡ numerous instances of the success of this mode of operating, all the patients being immediately more or less relieved, and two being perfectly successful, though the patients were very ill at the time with hectic, etc. This mode of operating by the canula he thinks is preferable to the ordinary mode of incising the soft parts.

Estimate of the Operation.—In estimating the value of any of these modes of operating, the difficulties or objections applicable to each should not be overlooked. When the intercostal spaces are prominent, and the presence of liquid certain, the direct puncture of Velpeau is the best; when there is any doubt of the position of the liquid, then the ordinary operation by dissection of the layers would be preferable. Where, however, the diagnosis is positive, and the chances of failure from the accident of pushing forward the thickened membrane, instead of perforating it, is guarded against, the instrument of Wyman, of Massachusetts, may prove advantageous. In Boston, the experience of the profession is said to be favorable to it. Under all circumstances, the surgeon may anticipate an anxious and long-continued convalescence of the patient, and one which will exact all his skill as a practitioner to conduct the case to a favorable result.

The employment of a trocar is the most objectionable of the various instruments employed, as it is not so shaped as to obtain a keen edge, while the point of the canula, even when closely fitted to the shoulder of the instrument, is very liable to tear or push the pleura before it, as is occasionally seen in cases of hydrocele accompanied by thickening of the tunica vaginalis. When the surgeon recalls the constitutional effects liable to result from opening closed cavities, and especially those containing pus, from a free fibrinous deposit like a false membrane, he can readily foresee the consequences of opening the pleura in cases of empyema. The natural tendency of such collections is either to be absorbed or discharged by the efforts of nature. If discharged by nature, the inflammation of the surrounding parts and the character of the opening made by ulceration are well known to be more favorable to a cure than is the case when the surgeon punctures it. I would, therefore, express the opinion that this operation should not be resorted to until the latest possible moment; that, when done, air should be prevented from entering the cavity of the chest; that the pus should be slowly and only partially discharged, the wound closed, and the operation repeated if necessary. If, however, the entrance of air cannot be prevented, it will be better to evacuate the whole of the liquid, and treat the case subsequently like one of cold abscess.

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* New York Journ. Med., Jan. 1858, p. 42.

† New York Med. Times, vol. ii. p. 337, 1853.

‡ Transact. Am. Med. Assoc., vol. iv. p. 245.

The value of this operation has been very differently estimated at various periods, most of the surgeons, up to the time of the discovery of Laennec, having regarded it as either doubtful or dangerous, and especially from the difficulties attendant on the diagnosis. Since the more general resort to auscultation, many of these difficulties have been removed. Disease of the lungs are now no longer confounded with those of the pleura, and a skillful auscultator can, in most instances, render the knowledge of the presence of a liquid in the chest absolutely certain.

But, though the cases can now be better selected than they were formerly, a successful result is not always obtained. The true value of the operation may, it is thought, be correctly stated thus: Thoracentesis will always afford temporary relief, and about one-half of the cases will recover; but whether these patients would have died without it, is difficult to tell.

The idea is certainly erroneous that paracentesis thoracis is an eminently successful operation, and though its results have sometimes been such as to justify its performance, the prognosis should be guarded, as it is shown that the mortality has been considerable, and the objections that were raised against the operation in former days should, therefore, not be slightly disregarded. They are thus stated by Velpeau:—

If the lung has been forcibly compressed by the liquid, and yet is permeable, the evacuation of the liquid without the entrance of air into the pulmonary cavity may distend it so rapidly as to excite violent inflammation. If, on the contrary, the lung has shrunk so much as to yield but slowly to the entrance of air, the void which is immediately left about the parts is very liable to derange the respiration and pectoral circulation, while the introduction of air into the cavity of the pleura, though obviating this, yet exposes the patient to danger by exciting inflammation and creating unhealthy pus, thus giving rise to adynamic symptoms, under which many have died.

Barlow also states* that his faith in the utility of this operation has very much waned of late, and believes that the majority of the cases operated on would have done equally well without it.

§ 3.—Effusions into the Pericardium.

A collection of fluid within the cavity of the pericardium, when the result of chronic disease, has occasionally been deemed a proper subject for an operation, and several surgeons have, from time to time, reported instances in which they have successfully opened the investing membrane of the heart, and given exit to the fluid which had been the source of such great distress to the patient. As, however, this relief can only be temporary, and as the patient is exposed to considerable danger from various steps in the operation, surgeons have not been disposed to advocate it. In fact, the rare occurrence of such condition as would justify a resort to the operation has not offered a sufficient number of cases to test its value. Velpeau, in analyzing the few cases that have been reported, expresses the opinion that doubt may be attached to all except the one performed by John C. Warren, of Boston, and reported hereafter. His operation has also been described to the author personally as successful, and is, it is thought, the first positively successful case on record.

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* London Med. Times and Gazette, No. 7, 1857.

Operation of Jno. C. Warren, for Effusion into the Pericardium.—A respectable female, aged about thirty-five years, having suffered considerably from palpitation and dyspnœa, with the other signs of hydrops pericardii, Warren operated as follows: An incision being made on the face of the seventh rib, the integuments were drawn upward to the sixth intercostal space, and the tumor or prominence, which was very marked, carefully punctured with a small trocar and canula, the pericardium being easily reached. Between five and six ounces of serum being thus evacuated, the wound was carefully closed, the chest bandaged, and the patient recovered sufficiently in a few weeks to leave the Massachusetts General Hospital, but was not heard of subsequently.

Operation of Schuh.—Another successful case of tapping the pericardium is related by Walshe,[*] in which Schuh introduced the trocar and canula in the fourth intercostal space, or between the fourth and fifth ribs, and drew off upwards of a pint of reddish serum, which flowed in gushes that corresponded with the systole of the heart. This patient was also very much relieved, and in the course of the month bid fair to be cured, but six months subsequently died of an encephaloid growth near the trachea. The *post mortem* showed that the operation had been perfectly successful, and that the pericardium was adherent to the heart by thick areolar tissue.

AMERICAN PAPERS ON THE DISORDERS OF, AND OPERATIONS ON, THE NECK AND TRUNK.

ON EXTIRPATION OF THE PAROTID GLAND.

A Case of successful Extirpation of the whole of the Parotid Gland for Scirrhus, by George M'Clellan, M.D. Philadelphia.—*N. Y. Med. and Phys Journal*, vol. v. p. 649, 1826; also *Am. Med. Review and Journ.* 1826.

The operation of Warren, of Boston, in 1798, was the first case; that of M'Clellan, of Franklin County, Pa., in 1805, the second; that of White, of Hudson, in 1808, the third; that of Sweat, of Maine, in 1811, the fourth; and the operation of Geo. M'Clellan, referred to in his paper, was the fifth time it was repeated in the United States, though the first published.

Case of Extirpation of the Right Parotid for Melanotic Enlargement, by George M'Clellan, M.D. Philada., 1829, being his second case—*N. Y. Med. and Phys. Journ.*, vol. ii. N. S. p. 309. 1830.

An Account of the Extirpation of the Parotid Gland, by George M'Clellan, M.D. Philada.—*West. Journ. of Med. and Phys. Sciences*, vol. iv. p 465. 1831.

A Case of Extirpation of the Parotid Gland, by Valentine Mott, M D. New York.—*Am. Journ. Med. Sciences*, vol. x. p. 17. 1831.

Three Cases in which the Parotid Gland was successfully removed, (Dec. 14, 1827, Sept. 16, 1830, and one not dated,) by George Bushe, M.D. N. York.—*Medico-Chirurgical Bulletin*, vol. ii. p. 133. 1832.

Extirpation of the Parotid Gland, with other Cases, by Nathan R. Smith, M.D. Baltimore.—*Am. Journal Medical Sciences*, vol. xxiii. p. 59. 1839.

A Case of Extirpation of the Parotid Gland, by J. Randolph, M.D. Philadelphia.—*Am. Journ. Med. Sciences*, vol. xxiii. p. 517. 1839.

A Case of Extirpation of the Parotid Gland in 1805, by John M'Clellan, M.D. Franklin County, Pa.—*Amer. Journal Medical Sciences*, vol. vii. N. S. p. 499. 1844.

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[*] Walshe on Cancer, p. 366, Lond. edit.

Extirpation of a Scirrhous Parotid Gland, by H. H. Wheeler, M.D. Pennsylvania. —*Am. Journ. Med. Sciences*, vol. ix. N. S. p. 520. 1845.

Extirpation of the Parotid Gland, by Wm. E. Horner, M.D. Philadelphia.—*Phila. Med. Ex.*, vol. vii. N. S. p. 30. 1851.

Successful Removal of the Parotid Gland. by A. J. Wedderburn, M.D. N. Orleans. —*N. Y. Journ. Med*, vol. vii. N. S. p. 411, from *N. O. Med. Register*. 1851.

Cases (three) of Extirpation of Parotid Glands. (one in 1811, one in 1814, and one in 1841, cured.) by Moses Sweat, M.D. Maine.—*New York Journal of Medicine*, vol. vii. N. S. p. 23. 1851.

Extirpation of the Parotid Gland, (under chloroform,) by A. B. Shipman, M.D. N. Y.—*Nelson's North. Lancet*, vol. vi. p. 143. 1852.

Successful Extirpation of a Scirrhous Parotid Gland, by J. Mason Warren, M.D. Boston.—*Amer. Journ. Med. Sciences*, vol. xxiv. N. S. p. 332. 1852.

Removal of the Parotid Gland, (cured.) by H. H. Toland, M.D. San Francisco.—*Charleston Med. and Surg. Journ.*, vol. viii. p. 78. 1853.

Extirpation of the Parotid Gland, by John P. Mettauer, M.D. Va.—*N. O. Medical and Surg. Journ.*, vol. xi. p. 234. 1854.

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ON DEFORMITIES OF THE NECK.

A Case of Division of the Sterno-Cleido-Mastoid Muscle, for Wry-Neck, by J. Mason Warren, M.D. Boston.—*Boston Med. and Surg. Journ.*, vol. xxv. p. 121. 1841.

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A Case of Torticollis successfully treated by Myotomy and an Apparatus, by John B. Brown, M.D. Boston.—*Boston Med. and Surg. Journ.*, vol. xxvi. p. 58. 1842.

Cases of Wry-Neck cured without cutting, (gradual extension by the hand applied to the head, the patient being in a state of anæsthesia,) by Gurdon Buck, Jr., M.D. New York.—*N. Y. Med. Times*, vol. ii. p. 131. 1852.

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Case of Stricture of the Œsophagus, (with a new Instrument for its Relief,) by H. G. Jameson, M.D. Baltimore.—*Med. Record*, vol. viii. p. 1. 1825.

Description of an improved Instrument for extracting Poisons from the Stomach, with Statements assigning the Credit of the Invention of the Stomach-Tube to P. S. Physick, M.D., in 1800, (he being then ignorant that Monro, of Edinburgh, had done the same thing,) by C. B. Matthews, M.D. Philada.—*Am. Med. Record*, vol. x. p. 322. 1826.

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Three Cases of Bronchotomy, by S. Annan, M.D. Emmetsburg.—*Am. Med. Recorder*, vol. vii. p. 42. 1824.

Case of Tracheotomy (successful) for the removal of a Watermelon Seed, by Henry S. Waterhouse, M.D. Franklin County, New York.—*Philad. Journ. of Med. and Phys. Sci.*, vol. viii. p. 391. 1824.

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Two Cases of Bronchotomy, (in which one was cured, one died,) by Richard Burgess, M.D.—*Am. Med. Recorder*, vol. vii. p. 111. 1824.

Case of Tracheotomy for the removal of a Bean, (cured,) by Calvin Jewett, M.D. Newberg, Vermont.—*New Eng. Journ. of Med. and Surg.*, vol. xiii. p. 237. 1824.

Case of Laryngotomy for a Watermelon Seed, (cured,) by Samuel A. Cartwright, M.D. Natchez.—*New Eng. Journ. of Med. and Surg.*, vol. xiv. p. 135. 1825.

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Laryngotomy in consequence of Suffocation from Enlarged Tonsils, (died,) by J.

Mason Warren, M.D. Boston.—*Am. Journ. Med. Sci.*, vol. xxiv. N. S. p. 96. 1852.

Tracheotomy successfully performed, (for Asphyxia from Acute Laryngitis,) by Joseph Pancoast, M.D. (Communicated by Joseph Mauran, M.D. Providence.)—*Boston Med. and Surg. Journ.*, vol. xlvii. p. 17. 1852.

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Cases of Polypus Laryngis, by Willard Parker, M.D. New York. (Reported by Stephen Smith, M.D., New York.)—*N. Y. Journ. Med.*, vol. viii. N. S. p. 15. 1852.

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Tracheotomy for a Foreign Substance (Grain of Corn) in the Trachea, by B. F. Trabue, M.D. Kentucky.—*Am. Journ. Med. Sciences*, vol. xxv. N. S. p. 556. 1853.

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Laryngotomy for Syphilitic Disease, by Geo. Amerman, M.D. New York.—*Am. Journ. Med. Sci.*, vol. xxxiii. N. S. p. 284. 1857.

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PART XIV.

DISORDERS OF, AND OPERATIONS ON, THE ABDOMEN.

CHAPTER I.

THE **Parietes of the Abdomen,** like similar tissues elsewhere, are liable to the development of tumors of various kinds, the fibrous and lipomatous being those most frequently met with. As the removal of these tumors is to be accomplished on the same general principles as those already designated in the account of the neck, this slight allusion to them may be sufficient to preserve the continuous arrangement of the subject adopted as the order of the present work.

Within the walls of the abdomen there are, however, such a variety of organs that their surgical disorders require a more detailed consideration; and while reserving the account of Hernia for another chapter, and the operations upon the genito-urinary organs through the abdominal parietes for another PART, there remains to be described the surgical treatment adapted to the relief of certain disordered conditions of the peritoneum, liver, stomach, and intestines.

As the surgical anatomy of these organs does not offer any points worthy of special consideration, when we exclude such details as are generally presented in an account of their special anatomy, the operations demanded for the relief of affections of the peritoneum may first claim attention; after which, those required by some of the disorders of the abdominal organs will be referred to.

In doing this I shall, however, limit my descriptions to such as are generally recognized as justifiable; extirpation of the spleen or scirrhus of the pancreas not being included in this class.

SECTION I.

PARACENTESIS ABDOMINIS.

The accumulation of such an amount of serum within the peritoneal cavity as seriously interferes with respiration, has usually been deemed sufficient cause to justify its evacuation by an operation, although little more than temporary relief can be anticipated, unless the cause of the effusion is of a comparatively slight character and amenable to a constitutional treatment.

Ordinary Operation of Paracentesis Abdominis.—Having prepared a good flat trocar and canula, surround the patient's belly with a broad bandage, the ends of which should be cut into tails, crossed upon the back, and drawn tight by assistants, in order to keep up constant pressure upon the abdominal cavity as the liquid escapes; or the same pressure may be effected merely by the pressure of the assistants' hands; or, in debilitated patients, the escape of the liquid may be left entirely to the contraction of the abdominal walls, which will thus regulate the flow of the liquid and the rapidity of its escape. The surgeon, being then perfectly satisfied of the correctness of his diagnosis, has only to push the trocar through the abdominal parietes near the median line of the abdomen, about two inches below the umbilicus, and, withdrawing the trocar, allow the fluid to escape through the canula until he is satisfied that sufficient has been evacuated, when, removing the instrument, he should close the wound by a piece of adhesive plaster, and cover this with a compress and bandage.

Remarks.—Simple as this operation evidently is, surgeons have differed somewhat in regard to the details of its performance. Thus, some have advised that the patient should be seated, others that he should be lying down; some have recommended the entire evacuation of the fluid at the first operation, while others direct the removal of only a part of it; some have selected the trocar and canula, as mentioned in the preceding account of the operation, and others preferred the use of a lancet and catheter. As these differences are chiefly the result of individual opinion, the surgeon, in deciding upon the advantages of one method over another, must, of course, be guided by the peculiarities of the case. Physick* always advised making the puncture with a lancet, and then introducing a flat canula or female catheter; and this will be found to constitute a safe and easy mode of operating. The use of the catheter has, however, been recently claimed for Fleming, of the Val de Grâce,† though it had, as is shown above, been employed many years before his suggestion was announced.

Physick's Operation.—The patient lying down near the edge of the bed, with a piece of oil-cloth under him, a lancet was inserted through the abdominal parietes in the line of the linea alba, about two inches below the navel, the fluid being allowed to escape through the puncture as soon as it was removed. After the liquid had partially escaped, and the stream began to diminish, a female catheter was introduced into the peritoneal cavity, in order to favor the further evacuation of its contents. The subsequent dressing was the same as in the ordinary operation.

Estimate.—The advantage of the operation recommended by Physick will be found in the slight pain caused by the puncture; in the greater tendency of the parts to heal; in the impossibility of pushing the peritoneum, especially in encysted dropsy, in advance of the instrument; in the patient being less likely to faint when lying down than when sitting up; and in the more gradual evacuation of the fluid permitting the abdominal parietes to accommodate themselves to the vacuum otherwise liable to be left in the abdomen, unless the belly is kept well bandaged. As it is also well known that incised wounds are less liable to inflammation than punctured, the chances of peritonitis are hereby diminished. Whether the proposal to excite inflammatory action in the sac of the peritoneum by injecting iodine, or similar articles, will ever be generally adopted, is at present a matter of doubt, and sufficient data have not yet been obtained to authorize it as an operative proceeding.

The horizontal posture of the patient throughout the operation has long been regarded with favor by many in the United States; I always resort to it, and so has Storer, of Boston, during the last ten years. In Europe, however, it appears to be regarded as a novelty, and has been lately advocated by Simpson, of Edinburgh, as a new suggestion.

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* Dorsey, Surgery, vol. ii. p. 365.

† Malgaigne, Philad. edit. p. 387.

SECTION II.

HEPATIC ABSCESSES.

The production of inflammatory action in the liver, as the result of disease or injury, especially as alluded to in Wounds of the Head, has not unfrequently terminated in the formation of pus, which, if allowed to accumulate, has a tendency to cause a disintegration of the secretory portion of the gland. This purulent collection, like abscesses elsewhere, will often be evacuated solely by the efforts of nature, the matter sometimes escaping through the diaphragm, lung, and bronchia, whence it is expectorated; or flowing into the cavity of the pleura, so as to constitute one source of empyema; or the abscess may open into the stomach, bowels, or cavity of the abdomen, or it may tend toward the abdominal parietes, and be evacuated externally like a superficial abscess. As it is a matter of some consequence to prevent any great increase in the amount of the collection, which is apt to be the case if the complaint is left too long to the powers of nature, the surgeon may be required to aid the progress of the pus to the surface by means of an operation, care being taken to insure the adhesion of the liver to the abdominal parietes, before attempting any puncture.

Diagnosis.—When an abscess of the liver tends to point outwardly, it creates a swelling or tumor, which is quite apparent through the abdominal parietes. This may show itself at various points; sometimes it has been found on the back near the vertebral column; at others the matter has traveled nearly as low as the spinous process of the ilium, though most frequently it has been found under or near the false ribs.

Other tumors may, however, occupy the same point, and it has been found so difficult to distinguish hydatids, encysted, or fatty tumors of this region, from the swelling caused by a hepatic abscess, that Récamier has proposed to test the contents of such tumors by the exploring needle. As such a test exposes the patient to the risks of peritonitis, from the escape of even a small quantity of pus into the surrounding parts, this means of diagnosis is generally discountenanced. The best means of arriving at a correct conclusion will be found in studying the history of the case, in watching for the signs of fluctuation and inflammation about the part. If the exploring needle is employed, such a portion of the contents as can be obtained should be carefully examined under the microscope, as the microscopical and chemical examination of the constituents of bile, with the well-known characteristics of pus, will render the diagnosis of supposed hepatic abscesses much more certain.

When a diagnosis is established, it is of much importance to evacuate the collection promptly; and to do this, resort may be had either to caustics or puncture, or to both, (Récamier;) or to a dissection and puncture, after adhesions have formed between the peritoneum, covering the liver and that lining the abdominal walls, (Begin.) To the latter mode of operating I give the preference.

Operation of Begin, of France.—Make an incision two or three inches long upon the most prominent part of the swelling, and divide with great caution the layers of the abdomen—as is done in hernia—until the peritoneum lining of the abdominal parietes is reached. Raise this carefully with

PLATE XXXIX.

OPERATIONS PRACTICED ON THE ABDOMEN.

Fig. 1. Evacuation of a Hepatic Abscess. An eschar has been formed near the abscess, in order to favor the adhesion of the adjacent serous surfaces, after which the puncture has been made by the bistoury. 1. The eschar produced by caustic. 2. The bistoury puncturing the abscess. 3. Pus escaping through the puncture. *After Bourgery and Jacob.*

Fig. 2. Manner of enlarging an abdominal wound in order to favor the restoration of the prolapsed intestines. After the fingers of one hand have gently separated the intestinal convolutions, and the forefinger is insinuated at the upper angle of the wound, the bistoury is to be passed along the finger with its back toward the finger-nail, and, being introduced, enlarge the wound by slightly incising the abdominal parietes upward. *After Bourgery and Jacob.*

Fig. 3. A longitudinal wound of the intestines, closed by Pellier's suture. While the left hand of the surgeon holds the two ends of the thread, the right hand is occupied in replacing the protruded bowel, commencing at that part which last escaped from the abdomen, and retaining the ends of the suture to attach the wounded intestine to the abdominal parietes.

After Bourgery and Jacob.

Fig. 4. Transverse wound of the intestines about to be treated by the method of Reybard. 1. The wound. After introducing the plate through the intestinal opening, and applying the suture, the parts are to be restored.

After Bourgery and Jacob.

Fig. 5. Enteroraphy as performed in the method of Ledran. 1. The puckered surface of the intestine. 2. Line of the wound. 3. The various sutures collected together, and twisted into a cord. *After Bourgery and Jacob.*

Fig. 6. Taxis, as practiced upon an external inguinal hernia of the left side, the surgeon standing on the right side of the patient, and manipulating the tumor as directed in the text. *After Bourgery and Jacob.*

Fig. 7. Taxis, as performed upon reducible crural hernia, on the right groin of a man, the operator being placed on the patient's left side. The palm of the hand inclosing the tumor pulls it toward the saphenous opening, while the fingers of the same and opposite hand press the viscera vertically upward toward the femoral ring. *After Bourgery and Jacob.*

Plate 39.

Fig. 1

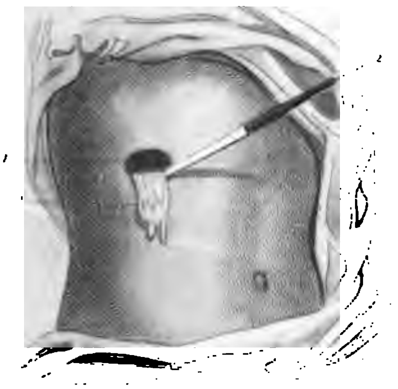


Fig. 2

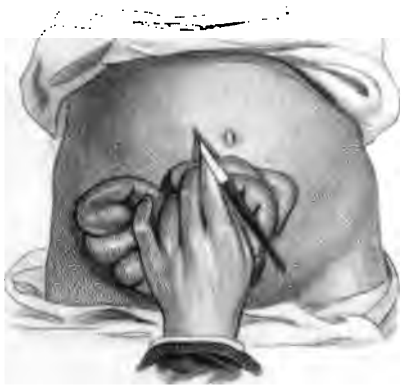


Fig. 5

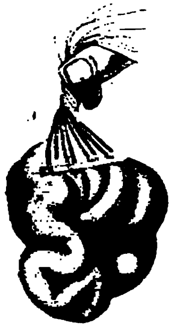


Fig. 3

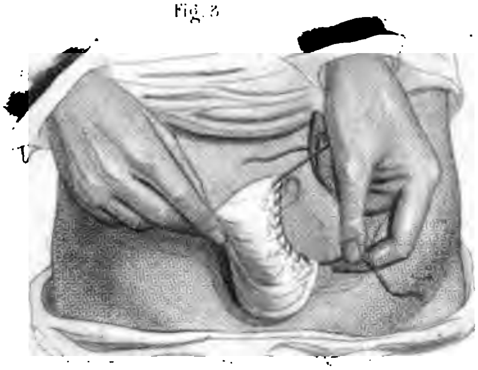


Fig. 4

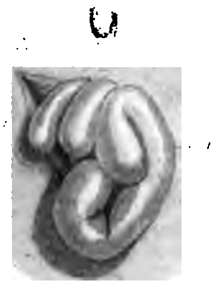


Fig. 6.

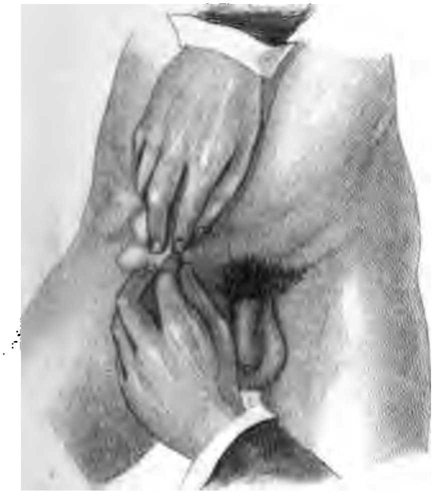
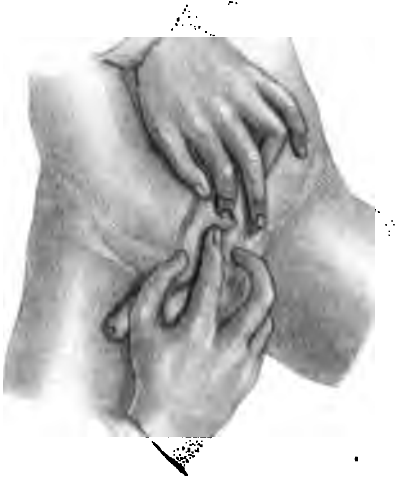


Fig. 7



the forceps and nick it, dividing it subsequently upon the director. If the intestine presents itself, push it to one side; but it should be remembered that when the patient is well etherized, there is but little tendency in the bowels to move toward the wound, and that this direction will therefore be seldom needed. On reaching the surface of the tumor, the operation should be temporarily arrested, the wound filled with lint, and the parts closed by a compress and bandage; and after three or four days, or when adhesions have taken place between the swelling and the peritoneum, the abscess may be opened, the diet being always strictly regulated, Plate XXXIX. Fig. 1.

Operation of Savery, of New Hampshire.—An intemperate man, aged sixty, after laboring for some years under chronic hepatitis, presented a circumscribed swelling in the right hypochondrium, which became pointed and painful, and gave an obscure sense of fluctuation. An incision was therefore made into the abscess, and nearly a gallon of sero-purulent fluid discharged, the last portion evacuated having all the properties of bile. A broad bandage having been carried around the body some time previous to the incision, was then gradually tightened as the swelling diminished, so as to keep the parts in apposition. The discharge continued for a few days, and then ceased; but considerable constitutional irritation existed during the first week, and required the free use of wine and sulphate of quinia, with other appropriate remedies.

Remarks.—The opening of a hepatic abscess would be a very simple measure, were it not for the doubts that are often excited as to the actual existence of pus, and the difficulty of judging whether adhesions have formed between the parietes of the liver and those of the abdomen. Until the latter exist, the evacuation of the pus must expose the patient to the risk of the peritonitis, consequent on its escape into the peritoneal cavity. The application of the bandage, as employed by Savery, may therefore be regarded as a valuable addition to the operative proceeding recommended by Begin, as it not only tends to approximate the abdominal parietes and the liver, but also diminishes the cavity of the abscess, by compressing its walls, and thus favoring its adhesion.

The necessity of an active constitutional treatment in connection with this operation need only be mentioned, as every surgeon would doubtless resort to it under such circumstances.

SECTION III.

HYDATIDS OF THE LIVER.

The occasional development of **Hydatids of the Liver** demands that a few words should be said in relation to the operation which is sometimes required for their removal.

Although rarely met with, the existence of hydatids of the liver gives rise to a train of symptoms which, when tested by "exclusion," has enabled the surgeon to diagnosticate their presence, and operate for their relief. In a case reported by J. Edward Weber, of New York,* a tinsmith had suffered for nine years from an enlargement of the right side, over the region of the liver, which felt hard, and was more apparent when he had abstained from food. Being some time subsequently attacked with severe pain, he became conscious, during each inspiration, of a sensation in the side, which gave to his hand an impression similar to that caused by the purring of a cat. The diagnosis of hydatids of the liver having been satisfactorily established, it was determined to evacuate the cyst so as to unite its walls, or cause them to shrink, and he decided to do so by an operation, which he performed as follows:—

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* New York Med. Times, May, 1852.

Operation of Weber.—The bowels having been freely moved, an exploring trocar was thrust a few inches through the integuments into the most prominent part of the swelling, the sensation caused by the passage of the instrument being similar to that perceived in paracentesis abdominis. On withdrawing it, a fluid resembling whey dropped from its orifice, the microscopical examination of which revealed nothing remarkable. A longitudinal incision, two inches long, being then made down to the liver, a direct puncture of the liver with the trocar gave the same results. As there was no union of the peritoneal surfaces, a well oiled tent was introduced upon the peritoneum, in order to produce a limited inflammation, the end of the tent being left in the lower angle of the wound. During six days the patient complained of slight pain in a circumscribed space, of the size of the hand. Eighteen days subsequently, as it was supposed that adhesions had taken place, the second operation was commenced. The first incision having contracted, it was enlarged upwards of an inch, when, the finger having detected perfect adhesions between the abdominal peritoneum and that covering the liver, an incision was made through the parietes of the liver into the cavity of the cyst, which was thought to be of the size of the adult skull. The contents, which consisted of a fluid and small cyst, being now very cautiously evacuated, another oiled tent was introduced as before, and after a tedious recovery, and the presence of a hepatic fistula, the patient recovered in about twenty-two months after the first operation.

SECTION IV.

GASTROTOMY OR ENTEROTOMY.

Gastrotomy—*γαστηρ*, the belly, and *τομη*, incision—is a term which has been somewhat indefinitely applied to any incision upon the parietes of the abdomen, by which its contents could be exposed. The word is, therefore, sometimes employed to designate the opening of the uterus in the Cæsarean section, or the incision practiced for the removal of ovarian tumors, though it should be limited to such operations as directly expose the stomach; enterotomy designating the similar operations practiced on the intestines, ovariotomy the removal of ovarian tumors, and herniotomy that employed for the relief of protrusions of the bowels.

Either gastrotomy or enterotomy must, however, continue to be very rare operations, the risks of general peritonitis, as well as the possession of less difficult plans of treatment, rendering surgeons indisposed to resort to them. These operations have therefore been chiefly performed in order to remove such foreign bodies as were not likely to pass through the alimentary canal, as in the three cases quoted by Watson, of New York,* from the German Epherides, in one of which a knife which had been swallowed with the blade open, and ten inches long, was extracted by a longitudinal incision two inches long in the left hypochondriac region, and the patient recovered; in another, in which a knife seven inches long was also successfully removed by a similar incision, the cure being very prompt; and, in a third, a knife of nine inches being successfully removed in the same manner. **Enterotomy** has also been performed in order to overcome the intestinal obstruction in cases of volvulus.

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* Am. Journ. Med Sciences, vol. viii. N. S. p. 330.

§ 1.—Gastrotomy.

Gastrotomy, or the incision of the abdominal parietes, in order to open the cavity of the stomach, is an operation that has been recently suggested in cases of impermeable stricture of the œsophagus, in order to permit the introduction of nutriment, and has, as just stated, also been resorted to for the removal of foreign bodies of such size as to preclude all reasonable hope that they could otherwise be evacuated, as in the case reported by Marcet, where a sailor swallowed a number of clasp knives. Although gastrotomy is an operation that could seldom be justifiable, yet under such circumstances as have been referred to in the account of Œsophagotomy, and with our knowledge of the wonderful recoveries of patients under extensive wounds of this viscus, of which several cases are cited,* it must be admitted that there are instances in which the surgeon might be induced to advise its performance.

Operation of Opening the Stomach.—As the mere operative proceedings connected with the exposure of the stomach cannot require any extended detail for the instruction of one who is familiar with the anatomical relations of this organ, it seems to be only requisite to state that the general course of proceeding would be very similar to that just detailed for the treatment of hepatic abscess; or, in more definite terms, cut through the abdominal parietes with caution, over the front of the stomach in the line of the linea alba, extending from an inch below the ensiform cartilage, to an inch and a half above the umbilicus, until the peritoneum is exposed; carefully open the portion which lines the abdomen; hook or seize the front surface of the stomach between its curvature; stitch it fast to the abdominal parietes, and then wait, if possible, for adhesion to occur, before puncturing the viscus, lest its liquid contents should escape into the peritoneal cavity, when, if the patient is able to sustain the constitutional shock, or peritonitis that may ensue, it will subsequently be necessary to treat the wound so as to create a fistula, through which food might be introduced, as was done by Beaumont, in his experiments on digestion, as practiced in the celebrated case of St. Martin. Should gastrotomy, however, be attempted for the removal of a foreign body, such as a knife, or other large substance, similar to those that have been accidentally swallowed, and referred to by Watson, of New York, Marcet, and others, the wound should be made to unite as soon as possible, by a treatment analogous to that reported hereafter, in the case which occurred in the practice of Ashby, of Virginia, or in that now quoted.

In a case reported by Barnes, of a young peasant, who, while endeavoring to produce vomiting with the handle of a knife, let it slip into his stomach; it was removed by a surgeon named Shoval, in the following manner:—

Shoval's Operation in 1635 for the Removal of a Knife from the Stomach.—A straight incision being made in the left hypochondrium, two fingers' breadth below the false ribs, first through the skin and connective tissue, and then through the muscles and peritoneum, the stomach was exposed, but slipped from the fingers whenever it was attempted to be seized. Being at length caught with a curved needle, and drawn out of the wound, a small incision was made into it, through which the knife was easily extracted, when the stomach immediately collapsed. After thoroughly cleansing the external wound, it was united by five sutures, and tepid balsam poured into the interstices, and tents impregnated with balsam completed the dressing by closing the wound accurately. Two sutures being removed next day, and two more on the following day, the wound healed on the fourteenth day after the operation and the patient completely recovered. The knife, as seen by Oliver at Konisberg, in 1685, was six and a half inches long.

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* See Bibliographical Index, end of this part.

Extraction of a Bar of Lead from the Stomach.—John Bell, of Wapello, Iowa, successfully removed a foreign body from the stomach by the following operation:—

The patient, a man aged thirty-two, while performing the feat of running a bar of lead down his throat, accidentally let it slip, so that it descended into his stomach. At first, no evil consequences were observed, but three or four days subsequently he became unwell, and, when seen a week after the accident, was suffering with considerable gastralgia and abdominal soreness, with retching and vomiting of a dark, watery fluid; pulse small and tense, great anxiety, restlessness, prostration, and apparent sinking of the vital powers.

Operation of Bell.—Having administered chloroform, Bell made an incision from the point of the second false rib to the umbilicus, and divided skin, adipose tissue, and muscles, down to the peritoneum, which he laid bare the whole length of the incision. The peritoneum was then raised on a director, and divided the entire length of the incision. A considerable quantity of omentum and intestines were protruded through the wound at this moment; they were replaced, however, as speedily as possible, and the operator then grasped the stomach, in which he immediately discovered the bar of lead. The bar of lead, having been grasped by the thumb and middle finger, with the forefinger on the lower end of it, was pushed upward and backward, so as to make the incision in the stomach as high as possible, and then the coats of the stomach were divided over the extremity of the bar, by an incision parallel with the muscular fibres, and not larger than to admit of the removal of the lead. A long pair of forceps was then introduced, and the lead seized and withdrawn.

The external orifice was closed with the ordinary interrupted suture and adhesive straps, a compress applied, and a roller put around the body.

The patient was dismissed, cured, the fourteenth day after the operation.

The bar of lead was ten and three-fourth inches long, and its weight nine and a half ounces avoirdupois.

This case is widely known, and is a remarkable instance of the success sometimes attendant on Gastrotomy.

§ 2.—Enterotomy.

Enterotomy, or the division of the abdominal muscles and their peritoneal lining, so as to permit the opening of a portion of the intestinal canal, has also been resorted to for the removal of foreign bodies, for the cure of volvulus, and in some instances for the relief of obstinate constipation, or for obstruction of the rectum in the formation of an artificial anus. Like the operation of gastrotomy, that of enterotomy can only be thought of in desperate circumstances, although the success which has attended the instances in which it has been employed has been sufficiently marked to have attracted attention. In a paper published by Phillips, of England,* it is stated that of 27 patients operated on for the establishment of artificial anus, 13 recovered. Of 53 cases referred to as operated on, for obstruction of the bowels, including both infants and adults, 17 were cured. He, therefore, advocates the operation in obstruction where three or four days have passed without relief from other means.

In cases of volvulus, the difficulty of the diagnosis must render the resort to an abdominal incision a most hazardous and uncertain operation; yet such operations have been performed, and, when the patient is under the influence of an anæsthetic, might be again employed with less risk and difficulty than has heretofore been the case. Although I doubt very much the propriety of these operations, as a general rule, and would urge the utmost caution in respect to diagnosis on the part of any surgeon who might be placed in such circumstances as apparently demanded them, I am convinced that they present some chances of success; and as such a concatenation of circumstances may occur as will demand their repetition hereafter, there seems to be a good reason for exhibiting the few facts that have been presented in connection with the subject. By referring to the Bibliographical Index of this part, several cases will be found in which the intestinal canal has been most rudely treated without causing death. In the case reported by Brigham, of Utica, a patient survived the removal of seventeen inches of the intestinal canal; in one reported by Dugas, of Georgia, the intestines were cut in two by a bowie knife and sewed up, yet the patient recovered; and in others there referred to, they sustained the rudest handling, and were even severed, without causing death. But, though success followed these cases, it is presumed that no judicious surgeon would take any of them as a precedent for an operation which is universally regarded as a forlorn hope, except under the urgent circumstances in which an operator is fully satisfied that the patient's chances of life are less before than they would be after the performance of the operation.

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* Brit. and Foreign Med. Review, April, 1849.

Enterotomy successfully performed by J. E. Manlove, of Tennessee.*—A negro, aged seventeen years, who had had no evacuation of the bowels for twelve or fifteen days, and was laboring under fever, etc., was on the fourth day found to be in the following condition: Abdomen enormously distended; breathing difficult; extremities cold; pulse very feeble and quick, and countenance anxious. A consultation decided that, although the operation of enterotomy promised but little benefit, yet the certainty of death without it justified its performance.

Manlove's Operation.—An incision being made in the median line of the abdomen, commencing about two inches below the umbilicus, and extending down toward the pubis four or five inches, the peritoneum and bowels along the lower half of the incision were found adherent. An opening of about a fourth of an inch in length was therefore made into the bowel nearest the wound, from which there escaped large quantities of flatus and liquid feces, as well as some of the medicine which had been taken a short time previously. A further examination showing that the intestines were united to the peritoneum by extensive adhesions at various points, within reach of the finger and probe, and that there was therefore but little probability of the escape of any liquid into the peritoneal cavity, the wound was closed by sutures and adhesive strips, except at the intestinal opening. The amendment in all the symptoms was prompt, the extremities becoming warmer, and the pulse fuller and slower within an hour afterward. On the next day the appetite was good, and the patient continued to improve, discharging the contents of the bowel through the artificial anus thus made until the seventeenth day, when he had an evacuation per vias naturales, the wound having nearly closed. Nine months after this, he was presented to the Tennessee State Medical Society for inspection, being perfectly well. The adhesions were supposed to have been the result of a contusion of the abdomen, received six months previously.

Remarks.—In the paper just quoted, there is also mentioned another marked instance of the success of this operation, in which Wilson, of the same county, performed enterotomy in a case of volvulus, drew out the intestines until he reached the obstruction, dissected the adhesions found at the invaginated portion, overcame the obstruction, replaced the bowels, and the patient rapidly recovered.

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* Boston Med. and Surg. Journ , vol. xxxii. p. 492.

Successful Enterotomy, and Removal of a Silver Teaspoon, by Samuel White, of Hudson, New York.*—A man, aged twenty-six years, suffered, in May, 1806, from rheumatism, when, after a severe relapse, he became delirious and bent upon self-destruction. On the 7th of July, he procured a full-sized teaspoon, with some fruit jelly, and forcing the spoon down his throat in the absence of his nurse, was enabled to swallow it, by pressing his fingers against the handle. He was then greatly agitated, talked much, and declared that no attempt could save his life. On the 9th, a spasmodic affection of the stomach, alternating every fifteen minutes with stupor, showed itself, during which he would throw himself violently about. This lasted during two hours, while the spoon probably passed the pylorus, when he suddenly fell asleep, became rational, and expressed great anxiety for relief. On the 25th of July, a cutting sensation, confirmed by the pressure of the hand when the abdomen was relaxed, led to the discovery of the spoon in one of the convolutions of the ileum near the line dividing the right iliac and hypogastric regions. It remained fixed in this position, with increased heat and irritation in the adjacent parts, till August 7th, when, fearing the consequences of further delay, it was decided to attempt its removal.

Operation of White.—An incision, three inches long, being made through the abdominal parietes, and parallel with the epigastric artery, extending upward to the level of the crest of the ileum, the peritoneum was opened with a lancet; the turn of the intestine, which contained the spoon-handle, protruded; the intestine pierced with the lancet over the end of the handle, and the spoon extracted by forceps. The divided edges of the intestine were then secured by the glover's suture, and the external wound closed with adhesive strips and lint.

Under simple dressings, the wound healed by the first intention, and the patient recovered.

SECTION V.

GASTRIC AND INTESTINAL FISTULÆ.

The formation of a fistula in the abdominal parietes, and a communication of it with the viscera of the part, may be produced by various causes. Like those resulting from strangulated hernia, (artificial anus,) these fistulæ nearly always present certain common symptoms, and may be relieved by very much the same general treatment. Most frequently they will be found to give rise to more or less excoriation and inflammation of the skin of the abdomen, in consequence of the escape of the discharges externally, while they also affect the nutrition of the patient, and expose him to a protrusion or even strangulation of the mucous coat of the bowels, in a manner analogous to that seen in prolapsus of the rectum. As illustrative of a simple plan of relieving this condition, the following case is cited :—

Fistulous Opening of the Stomach successfully treated by Pressure, etc., by Cook.†—A widow lady, aged thirty-nine years, had been attacked with constipation and violent pain at the pit of the stomach, which resisted every remedy until the nineteenth day, when a fistulous orifice showed itself. Six months subsequently she presented a fistula immediately by the side of the umbilicus, the external orifice of which was about the size of a buckshot, and, on removing the dressing, a gill of bile was suddenly discharged, after which a small quantity of (gastric ?) fluid came slowly away. The acrid character of these discharges had excoriated and inflamed the abdomen, and rendered it intolerably painful. On drinking a glass of water, the whole of it was discharged through the fistula in twenty seconds, and an examination, by a catheter introduced into the opening, therefore led to the conclusion that the opening was in the stomach near the pylorus.

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* New York Repository, vol. x. p. 367, 1807.

† Am. Journ. Med. Sciences, vol. xiv. p. 271, quoted from Western Journ. Med. and Phys. Sciences, Jan. 1834.

Treatment.—A beef-bladder, being cut open longitudinally, was spread with adhesive plaster and applied over linen spread with cerate, so as to cover the excoriated part, an opening being made in the dressing corresponding to the fistulous orifice, after which a firm bandage and compress were applied and the diet limited, nourishing enemata being resorted to in order to sustain the patient. The external irritation soon healed ; the bandage was gradually tightened, and a cylindrical compress employed, under which treatment the fistula was completely healed in thirty-days, and the patient subsequently regained her health.

Remarks.—Should the orifice of such a fistula fail to heal under similar measures, the surgeon might derive advantage from the use of escharotics, or of the actual cautery carefully applied. As the experiments connected with digestion, performed by Beaumont upon St. Martin, who also labored under one of these fistulæ, have long been before the profession, the reference to his paper before given will furnish sufficient evidence of the powers of nature under such circumstances, as well as the means employed by surgeon Lovell, U. S. Army, to obviate the inconvenience resulting from the creation of the opening. The eversion of the mucous membrane of the stomach or bowels, and its tendency to become strangulated at the orifice of the fistula, should always be guarded against by appropriate pressure during the treatment of the case, and especially in its early stages.

CHAPTER II.

WOUNDS OF THE ABDOMEN.

As wounds of this region have been already described, an allusion to the treatment of such cases as present protrusion and wounds of the viscera now require attention. As the abdominal contents, when once protruded, are often with difficulty replaced, not only in consequence of the contraction of the muscular fibres around the wound creating strangulation, but also from the peristaltic action of the bowels, causing the protruded intestines to be filled with solid or gaseous deposits, their treatment becomes the first point for consideration.

SECTION I.

WOUNDS WHICH CAUSE PROTRUSION OR STRANGULATION OF THE INTESTINES OR OMENTUM.

In treating such abdominal wounds as are followed by a protrusion of any of the viscera, it is the universal rule to endeavor to replace the protruding portion by manual means, aided by such a position of the patient, use of anæsthetics, and other constitutional measures, as will induce perfect relaxation of the tissues forming the anterior abdominal parietes, before enlarging the wound. Since the discovery of ether, the restoration of the stomach, intestines, or omentum, when protruding through an abdominal wound, is much more easily accomplished than was formerly the case. The following plan of treatment will, therefore, often succeed :—

Treatment.—Place the patient upon his back, with the shoulders elevated and the knees drawn up in order to favor the relaxation of the abdominal muscles, and then, by means of ether, produce perfect anæsthesia. As soon as this is accomplished, cleanse the protruding parts thoroughly from all foreign matter by squeezing water upon them from a sponge, and then gently seizing, between the thumb and fingers, that portion of the viscus which had last protruded, compress it lightly so as to force back its contents, endeavoring to carry it into the cavity of the abdomen by pressing upon it with the forefingers. The peristaltic action of the digestive canal being entirely arrested during anæsthesia, the muscles of the abdomen perfectly relaxed, and the diaphragm partly quiescent, success will often crown these efforts.

When the protruded portion is returned, it then remains to unite the sides of the wound by a few points of the twisted suture, and support them by adhesive strips and a bandage. But if it should be found impossible to accomplish the restoration in this manner, it may become necessary to introduce a director, and enlarge the upper angle of the wound a little by means of the probe-pointed bistoury, Plate XXXIX. Fig. 2.

When the protruded portion is omentum, the treatment will be very much the same unless strangulation has occurred, in which case it may become necessary to treat it as is recommended in a similar condition in hernia.

In cases in which the protruding viscus has been wounded, as frequently happens, the opening in it should be carefully approximated by one or two points of the interrupted suture, so placed as not to include the mucous coat, and then leaving the ends of the threads attached to the viscus, its opening may be made to correspond with that in the abdominal parietes.

Operation of C. W. Ashby, of Alexandria.—In a very marked case reported by Ashby, a boy, six years of age, fell upon the points of a pair of sheep shears, which he had in his hand, and drove the instrument into the stomach obliquely from above downward, so as to graze the left side of the sternum and the edges of the ribs. The external wound was flap-shaped, and through this nearly the entire stomach protruded, discharging its contents through an aperture about three-fourths of an inch long. Having placed a single suture in the middle of the wound in the stomach, nausea and vomiting ensued from the handling of the viscus, and the boy became so unruly as to prevent the restoration of the stomach, although the abdominal wound was several times enlarged. At this period, anæsthesia was induced by chloroform, and, after slightly enlarging the abdominal wound, the stomach was readily replaced, although the boy vomited freely, as before, from handling the organ. The wound in the stomach being then brought directly opposite that in the abdominal parietes, it was gently retained within the verge of the external wound by a single stitch, and lint wet with cold water was retained upon the part by means of a bandage. A large dose of opium was then administered; and on the fifth the wound discharged freely; on the sixth day the ligature came away, after which the recovery was rapid.

SECTION II.

WOUNDS OF THE INTESTINES.

When an **Intestine is wounded** in such a manner that the injured part can be seen through the opening in the abdominal parietes, it becomes necessary to treat it by such means as may induce union, and prevent the escape of the contents of the bowel into the cavity of the abdomen. These means vary somewhat, according to the extent of the wound, and its longitudinal or transverse direction, sundry suggestions having been made by surgeons at different periods, in order to accomplish this object, and yet diminish the risk consequent upon peritoneal inflammation.

Two kinds of wounds of the intestine require the application of sutures, the first being that in which the wound is longitudinal, the second that in which it is transverse, and the consideration of these various sutures will, therefore, be referred to separately, it being premised that, in every instance, it will facilitate the operation, and add to the patient's chances of life, to resort to the use of anæsthetic agents before commencing the operation.

When a wounded intestine presents itself, so that the injured point can be readily reached, the extent of the wound is the first point to which attention should be directed, the means of treatment being necessarily varied according to the nature of the injury. In small punctures, or those less than a third of an inch in extent, or those openings through the intestinal coats which are consequent on the strangulation and ulceration that ensue upon certain conditions of hernia, Sir Astley Cooper recommended that the sides of the opening should be gently gathered together, or pinched up, and then the adjacent portion constricted by tying a fine ligature around it, in a firm knot, the ends of the ligature being cut off close to the gut. This loop gradually ulcerating through the coats of the viscus, while lymph is effused upon the peritoneal surface, the ligature will be soon discharged by stool, without exposing the patient to the risks consequent on the escape of its liquid contents into the abdominal cavity.

But if the opening is more extensive, then resort must be had to some of the various sutures that have been recommended by surgeons at different periods: Albucasis, A.D. 1100, Guy de Chauliac, A.D. 1360, Ledran, Ramsdohr, Shipton, Travers, Thomas Smith, Gross, and others, having advised peculiar methods of treatment.

The different sutures that have been employed by these surgeons are usually designated as the glover's suture, which was suggested by Guy, and supported by the opinion of Heister; the suture of the four masters, in which a foreign body (trachea of an animal) was introduced into the intestine, in order to support the sides of the wound; the looped suture of Palfyn; that of Ledran; and the continued or interrupted suture, as recommended, with various modifications, by Reybard, Jobert, Bertrand, and others.

§ 1.—Sutures employed in Longitudinal Wounds of the Intestine.

The **Glover's Suture** may be formed by means of a straight round needle and a waxed thread, by passing the needle obliquely through the sides of the wound when held together by an assistant, the first point of the suture being made at one line from the upper angle of the wound, and at an equal distance from its edges. The thread being then drawn through to within a few inches of its end, the needle should be repassed through the edges of the wound, from the same side as it commenced on, and the wound traversed obliquely from side to side, so as to carry the thread over and over, from stitch to stitch, as in "whipping a seam." On reaching the lower end of the wound, the needle should be removed, and three or four inches of the thread be left. This and the first end being then held by the assistant, Plate XXXIX. Fig. 3, the surgeon should proceed to reduce the intestine, and on drawing the ends of the thread toward the abdominal parietes, cause the outer coat of the intestine to approximate the peritoneum lining the abdominal parietes, so that it may be made to adhere to the surface of the abdominal wound. Five or six days subsequently, one end of the thread should be cut off close to the abdomen, when, by gently drawing on the other, while the edges of the wound are supported, the thread may be withdrawn without deranging the adhesions.

The **Loop Suture of Ledran.**—Having prepared as many ordinary sewing needles and threads as he wished to make stitches, the edges of the wound were approximated, and each needle passed transversely to the line of the wound, at a distance of about a quarter of an inch from each other. The threads on each side being then tied together, the two bundles were collected together and twisted into one, so as to pucker up the edges of the wound, Plate XXXIX. Fig. 5.

Loop Suture of Palfyn.—A ligature being passed through the middle of the wound in the intestine, so as to leave a loop on its inside, the ends were left out of the external wound, so as to draw the serous coat of the intestine up to the peritoneum lining the abdomen, after which the abdominal wound was closed, and the threads fastened upon the skin by adhesive strips, Plate XL. Fig. 2.

Suture of Heyward.—A small, thin, and oiled piece of light wood, twelve to fifteen lines long, and four to six broad, being first introduced into the intestine at the wound with a piece of thread attached to it, each end of the thread was armed with a needle. After passing each needle from one side to the other, from the inside outward through the thickness of the intestine, and also of the abdominal parietes, the wooden plate was drawn upon so as to compress the peritoneal coat of the intestine against the serous lining of the abdomen, and close the wound hermetically. When the adhesions thus excited seemed to be sufficiently strong, that is, in about three days, the thread was withdrawn, and the little plate of wood left to be discharged by stool.

Suture of Jobert.—After cleansing the edges of the wound, this surgeon turned in the serous surface on each side with the needle, and passed the threads transversely through them, at sufficient distances to keep the serous membrane of each side in contact. Then the ends, being knotted and tied as in the interrupted suture, were left to come away by stool, or they were twisted and brought out of the wound, as in the suture of Ledran.

Suture of Bertrand.—The lips of the wound being approximated, pierce them both rather obliquely about two lines from their edges, and one from their extremity. Then repassing the needle in the same way on the opposite side, two lines further on, continue them in the same direction to the other end by a series of equal stitches. The intestine being reduced, fasten the end upon the abdomen, and three days subsequently cut off one end of the thread near the wound, and draw out the other, Plate XL. Fig. 1.

§ 2.—Suture of Transverse Wounds.

Suture of Ramsdohr.—Invagination of the two ends of the intestine being accomplished, this surgeon stitched them together by two or three points of the interrupted suture, reduced the intestine, and left the suture to the efforts of nature. If the mesentery interfered with the invagination, he excised it to a sufficient extent.

Suture of Jobert.—With a piece of silk passed at each end into a needle, Jobert operated as follows: After traversing the anterior part of the upper end from without inward with one needle, he then passed both needles from within outward through the lower end of the intestine, and after placing as many threads in this manner as were sufficient to unite the wound, invaginated the intestine by gentle traction upon the threads, and either knotted them on the outside of the inferior end, or brought them out of the wound in the abdomen, Plate XL. Fig. 3.

Suture of Lembert.—After preparing as many threads, each armed with needles, as seemed requisite, one needle was pushed through the coats of the intestine as far as the mucous membrane, from without inward, and then repassed from within outward, so as to come out about one line from the edge of the wound. Then passing it across the fissure, he carried it from without inward, at a similar distance from the opposite side of the wound, and brought it out again at a distance of about three lines from its point of entrance, Plate XL. Fig 4. All the threads being passed in a similar way, the serous surfaces were brought in contact, so as to force the lips of the wound to double inward, and form a sort of valve, Plate XL. Fig. 5, after which the knots were tied, the ends cut off, and the intestine reduced.

Remarks.—In the account of the different sutures just given, as adapted to the union of both longitudinal and transverse wounds of the intestine, a brief enumeration of such of the various plans as are deemed most available has been given. The importance of the subject, and the numerous experiments that have been performed upon animals in order to test the result of similar injuries in man, might perhaps have authorized the addition of much to the above account, but as this would have transcended the limits of this

PLATE XL.

SUTURES OF THE INTESTINES—ARTIFICIAL ANUS.

Fig. 1. Continued Suture for Longitudinal Wounds. 1, 1. Ends of the thread. 2, 2. Points perforated by the first stitch, showing the distance from end wound. 3, 4, 5, 6. Subsequent points, showing the distances to be observed between the several stitches, and their relations to the edges of the wound.
After Bernard and Huette.

Fig. 2. Looped Suture of Palfyn, to unite the sides of a wound, and bring the peritoneal coat of the intestine in contact with the abdominal parietes. 1. Abdominal parietes. 2. Intestine. 3. Longitudinal wound of intestine. 4. Loop of the suture as seen in the intestine. 5. Ends of the thread brought out and knotted on the abdomen. *After Bernard and Huette.*

Fig. 3. Suture of Jobert for Transverse Wounds. 1. First thread passed through the intestine. 2. Second suture. 3. Edges of transverse wound of intestine. 4. Mesentery. 5. Point at which it has been incised in order to favor the union of the two ends of intestine. *After Bernard and Huette.*

Fig. 4. Suture of Lembert for uniting Transverse Wounds of the Intestine by approximating the adjacent serous surfaces. 1. The first insertion of the thread. 2, 2. Its point of exit and re-entrance, or the second suture. 3. The third point. *After Bourgery and Jacob.*

Fig. 5. Profile of this Suture. **A.** The suture as first formed. 1. End of the thread. 2. First loop. 3. Portion of thread over the wound. 4. Second loop. 5. Termination of thread. **B.** Profile of this suture as finished. 1. Exterior knot.

Fig. 6. Artificial Anus, in which the ends of the intestine open upon the groin by separate orifices. 1, 2. Ends of the intestine. 3. Mesentery between them. 4, 5. The two anal orifices. *After Bourgery and Jacob.*

Fig. 7. Artificial Anus where the two ends of the bowel open by a single orifice. 1, 2. Upper ends of intestine. 3. Septum formed by union of the adjacent sides. 4. Lower orifice or point of the artificial anus.
After Bourgery and Jacob.

Fig. 8. Artificial Anus, showing the funnel-shape of the cavity near the orifice. 1. The cavity of the peritoneum. 2, 3. Ends of the intestine. 4. Intervening mesentery. 5. The septum. 6. Funnel-shaped orifice formed around the artificial anus by the peritoneum. 7. A probe passed into the orifice to show the course of the fecal contents. *After Scarpa, from Bernard and Huette.*

Fig. 9. Another view of the same. 1, 2. The intestines. 3. The septum. 4. The course of the contents of the bowel. *After Bernard and Huette.*

Fig. 10. The septum partially removed. 1, 2. The intestines. 3. The short septum. 4. The mesentery. *After Bernard and Huette.*

Fig. 11. A view of the Enterotome of Dupuytren as applied. 1. Abdominal parietes. 2. The instrument. *After Bourgery and Jacob.*

Fig. 12. Enterotome of Liotard applied. 1. The septum. 2. The instrument.
After Bourgery and Jacob.

Plate 40

Fig 1.

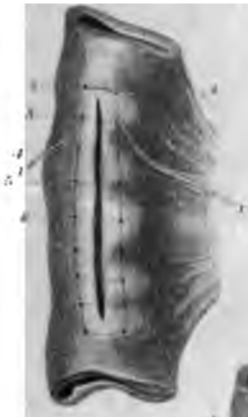

Fig 2.

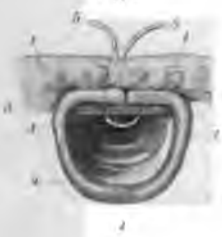

Fig 3.

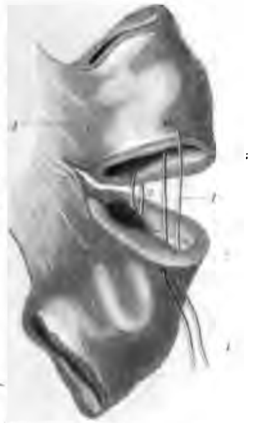

Fig 4.

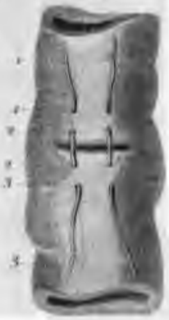

Fig 5.

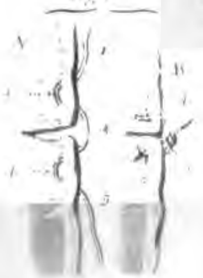

Fig 6.

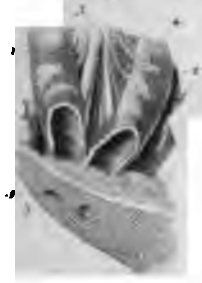

Fig 7.

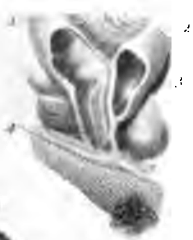

Fig 8.

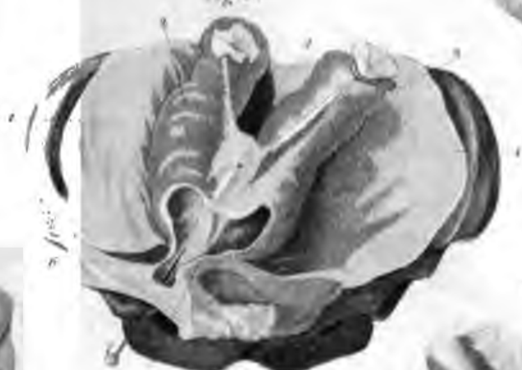

Fig 11.

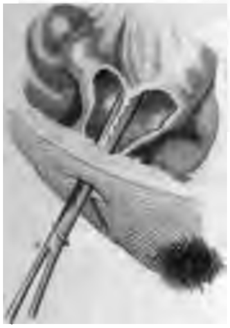

Fig 12.

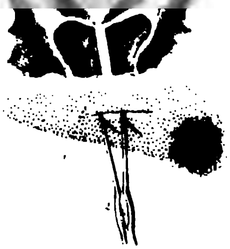

Fig 9.

Fig 10.

work, it must suffice merely to mention a few of the points generally admitted as settled in the treatment of these injuries.

From the experiments of former surgeons, and especially of Travers,* it appears that sutures of every description, when applied to an intestine and left unconfined at the external wound, ulcerate through into the bowel and are discharged by stool, the opening made by their escape through the intestine being closed by the effusion of lymph, and strengthened by adhesion of the edges of the ulcer to surrounding parts.

If a small portion of the intestine is encircled by a ligature, as was done by Sir A. Cooper, lymph is rapidly effused around the constricted point, and while the thread ulcerates into the bowel, the external coverings are reunited by new adhesions. But if the ligature surrounding a portion of the intestine is attached externally, it does not ulcerate through, but comes away in the same manner that the loop of the thread does from an artery.

As these facts have been established by the observations of Smith, of Philadelphia,† Gross, of Philadelphia,‡ as well as by many surgeons in Europe, no one can doubt the advantages of that mode of closing a wounded intestine which cuts off the ends of the thread and leaves the suture to be discharged per anum.

In the application of every suture, it is important that the stitch should not, if possible, pass through the mucous coat, but rather between it and the muscular coat; that the wound should be so accurately closed that fecal matter cannot escape; that two peritoneal surfaces be brought in contact in order to promote adhesions; that the bowels be kept as still as possible, and that every means be employed to keep down general peritoneal inflammation. Under proper treatment, and with the exhibition of sound judgment, moderate wounds of the intestine are by no means a hopeless class of injuries, various cases having been reported, in which patients recovered after most extensive injuries, and even the loss of seventeen inches of the intestinal canal. Although such a case could not be taken as exemplifying the usual result, yet it may be mentioned as a fact justifying the surgeon in forming a prognosis of a more favorable kind than might be the case if he trusted solely to general ideas on the subject, and induce him to exert his skill toward the preservation of life in even the most desperate cases.

Estimate of these Different Sutures.—For a small punctured wound, there can be no question that the application of the ligature, as advised by Sir A. Cooper, is the most advantageous; that the loop suture of Palfyn and Ledran comes next, according to the extent of the wound, and then the process of Jobert. In the union of transverse wounds, the interrupted suture is probably equal to any other. The plan of Ramsdohr is generally deemed objectionable from the difficulty of invaginating the part; from the necessity of incising the mesentery in order to permit it, and from the great tendency of the intestinal contents to escape into the abdominal cavity, owing to the want of accurate adjustment. The modifications usually spoken of as the plans of Denans, Duverger, or Amussat, in which a foreign substance is introduced to preserve the relative position of the two ends of the intestine, though more useful, are yet not without serious objections. The union of a transverse wound by the suture of Lembert is, therefore, thought to present the best prospect of an accurate agglutination of surface.

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* Inquiry into the Process of Nature in repairing Injuries of the Intestines, by Benjamin Travers. London, 1812.

† An Inaugural Essay on Wounds of the Intestines, for the degree of M.D. in the University of Pennsylvania, by Thomas Smith, Member of the Philadelphia Medical Society, 1805.

‡ An Experimental and Critical Inquiry into the Nature and Treatment of Wounds of the Intestines, by Samuel D. Gross, M.D. Louisville, 1843.

CHAPTER III.

OF HERNIÆ.

Hernia, or **Rupture,** is the name given to a disorder which consists "in a protrusion of any of the contents of the abdomen through natural or preternatural openings." As the existence of hernial protrusions is very common, about one in every eight of mankind being believed to labor under them, and as the complaint is one which either rapidly destroys life or exposes the patient to constant annoyance, it is not surprising that it has claimed and received so large a share of professional attention. From a very laudable desire to investigate the anatomical relations of a tumor which involves parts of such vital consequence, the examination of the structures through which herniæ escape has also been conducted with a degree of minuteness that has hardly left any shred or portion of the tissue concerned without a name. These details have consequently thrown a mist around the description that has confused and puzzled the brains of many students, who, under a less artificial account of the parts, would promptly have seized on all the facts possessing a practical value. The anxiety which has been shown to individualize tissues that in other parts of the body were scarcely noted, together with the habit of attaching to areolar tissue the inappropriate name of "fascia," has also tended not a little to add to the cloud which surrounds this disorder, as first presented to the mind of a young student; and though by subsequent study he may find that the various names given by different writers often designate the same part, it is long before the impression of extraordinary difficulty, which has been associated with the very term of hernia, wears away. That the profession have materially benefited by the details furnished by the distinguished anatomists whose names are identified with the subject of herniæ, cannot be denied; but that the student or inexperienced surgeon has been misled, when, knife in hand, he undertook to investigate the structure for himself, will, it is thought, be admitted by those who recall the earlier moments of professional experience.

A very material defect in the usual account of herniæ, as adapted to the wants of the surgeon, may also be seen in the tendency of anatomical teachers to present the relation of parts furnished by normal anatomy, instead of those shown in the pathological changes of the complaint; while, instead of describing the alterations of structure produced by disease, they present a perfect and minute detail of the disposition of tissues as found in subjects where no hernia has existed.

In an acccount like the following, which it is necessary to make as condensed as is possible, it is thought to be inexpedient to dwell long upon minute anatomical description; and in the subsequent sections there will, therefore, be first presented such general pathological facts as are applicable to Herniæ wherever found; after which such descriptions of the surgical or topographical anatomy of each region will be given as may be demanded for the explanation of the peculiar condition of tissues found in the three most common varieties of the complaint, to wit, **Inguinal, Femoral,** and **Umbilical Herniæ.**

SECTION I.

GENERAL PATHOLOGY OF HERNIÆ.

Any portion of the contents of the abdomen, as the bladder, uterus, or other organ, which protrudes through a natural or preternatural opening, constitutes a **Hernia**, though, in the majority of instances, the protruding part is composed of the intestines or omentum. As these viscera are so situated within the cavity of the abdomen as to have the great sac of the peritoneum in front and around them, it follows that their protrusion at any point will also involve a prolapse of this membrane, as well as of such other tissues as may be so situated as to be acted on by the protruding mass.

Etiology of Herniæ.—The causes of herniæ may be arranged under two separate heads: first, those which are *exciting*, and second, those which are *predisposing*. The exciting causes are such as act violently upon the abdominal parietes, as lifting heavy weights, blowing horns, jumping, and strains of every character. It is often excited in females by the tight lacing of corsets; while crying violently sometimes causes it in children. Pregnancy is also a common cause; and falls and blows, or any similar violence, may at any time induce the complaint in either sex.

The predisposing causes are a preternatural relaxation of the abdominal walls, or an unusual size of the various normal openings in the abdominal parietes for the passage of vessels. Thus, a very wide pelvis in the female is often a predisposing cause, because it creates a larger space beneath the crural arch, while the congenital deficiencies of the abdominal parietes, especially at the groin and umbilicus, greatly facilitate the production of herniæ on the subsequent application of slight exciting causes.

Envelopes of Herniæ.—The coverings of any hernia which protrude in front through the abdominal walls, necessarily consist of a portion of every tissue which is to be found between the skin and the peritoneum, unless violence has destroyed the continuity of the layers, or nature left in them a deficiency or opening through which the tumor could pass; or unless the distention of the structure has been so great as to lead to its absorption, or to its being so thinned as to escape our observation. Following the natural course of the most frequent varieties of hernia, and tracing it from the abdomen, we have, therefore, first to notice the **Sac**.

The portion of peritoneum pushed out in advance of a hernial tumor, or the "**Sac**," presents on its inside the smooth shining surface of a serous membrane, but, when irritated, displays the usual characteristics of serous tissues, by giving rise to effusions of serum which often fill the sac, or to effusions of lymph which glue together its sides and its contents, or very mûch increase or diminish its density from that seen in the normal condition of parts. Outside of the sac, or process of peritoneum, is generally seen a layer of areolar tissue of greater or less thickness, according to its position, which varies somewhat in its attachments to the peculiar region in which it is placed; thus, at the sides of the pelvis and groins it is loose and movable, while in front its adhesions are firmer and less easily overcome. In this extra-peritoneal areolar substance, or outer layer of the sac, are found the more important of the blood-vessels directly connected with the operations of strangulated hernia, and in it are also found the particles of fat which have occasionally been mistaken for omental hernia.

The changes made by disease in this areolar tissue are varied. When moderate pressure is made upon it, it becomes more developed, thickened, and laminated, acquiring a density and fibrous appearance which qualify it for the name of "fascia," which it has received; but when the pressure is very great, it becomes thinner and atrophied.

In the herniæ which are found to escape at the groin, this layer constitutes either the **fascia transversalis abdominis**, or the **fascia propria,** according to the views of different writers. Outside of this tissue are occasionally noted layers of muscular fibre, which are held together by the connective tissue which is always more or less spread around them, or by the condensed areolar structure which fills up the spaces left around the vessels. Outside of this again is found the **fascia superficialis**, or second grand tegumentary covering of the body, and outside of this is the skin.

When, however, long-continued pressure or inflammatory action has existed for some time, all these layers, which in the normal condition are easily distinguishable, will be found so blended and thickened as to have lost most of their ordinary characters and position, being fused, as it were, into one, or they may have their laminæ so increased that nearly twice as many layers can be made over a hernia as might be looked for in the natural envelopes of the part. When muscular fibre forms one of the laminæ covering a hernia, there is less change observed in it than is the case with some of the other tissues. Its presence may, therefore, generally be told by its normal fibres, and by these a distinction may be made of the different envelopes of the tumor which otherwise it would be very difficult to recognize, the extra-peritoneal and the subcutaneous fascia, or the areolar tissue outside of the peritoneum, and that underneath the skin, being sometimes so blended as to appear to the operator like a thickening of one and the same structure. The special coverings of each variety of hernia will be again referred to in connection with the particular class to which it belongs.

Seat of Herniæ.—The abdomen being a closed cavity, accurately filled by its contents, the different tissues which enter into the composition of its parietes naturally sustain an amount of pressure which varies according to circumstances. Above, or at the upper boundary of this region, the pressure is resisted by the diaphragm; but this septum is seldom the seat of rupture, in consequence of its mobility, though some of the intestines have occasionally been forced through it into the cavity of the chest, thus creating a **Phrenic** or **Diaphragmatic** hernia, which, when strangulated, is beyond the relief of operative means. Below, the abdominal contents are sustained by the bones of the pelvis and their connections, the resisting nature of which is so marked that herniæ are also rare in this direction, though they have been seen at some of its weaker parts, and especially at the point of exit of its arteries, as at the obturator foramen, or at the opening for the thyroid artery, (**Thyroidal Herniæ,**) at the sacro-sciatic notch, (**Ischiatic Herniæ,**) where the gluteal artery passes out, and also alongside of the vagina of the female, (**Vaginal Herniæ,**) or through a laceration of the perineum of the male, (**Perineal Herniæ.**)

Posteriorly, the abdominal walls are composed of the muscles of the loins and of the vertebræ, the former of which can alone give exit to herniæ, a few rare cases having been reported by Petit and Cloquet, and named **Lumbar Herniæ**, where the intestines protruded through the muscles immediately above the pelvis, after the parts had been wounded or submitted to extreme pressure.

As the natural tendency of gravity is to cause the abdominal contents to press against the anterior parietes of the abdomen when the patient is in the erect position, and as many weak points exist in the latter for the transmission of the various organs of the male and female, this region is by far the most common seat of herniæ in both sexes. In that part of the anterior parietes which is immediately at the line of the groin, there is also found openings for the escape of the spermatic cord, or of the round ligament of the uterus as well as of the femoral vessels, and it is at this point the **Inguinal** and **Femoral Herniæ** are seen. When an inguinal hernia passes into the scrotum it is called **Scrotal Hernia**; into the labia majora, **Pudendal Hernia**; when it is forced through the abdominal parietes at some usually strong point, it is known as **Ventral Hernia**; and if from this it slips into a part of the inguinal canal, it is called **Ventro-Inguinal.**

The hernial tumor has also been named according to its contents: thus, if it contain intestine, it is termed an *enterocele;* if omentum, *epiplocele;* and if both, *entero-epiplocele.*

Certain terms, moreover, are applied to the varieties of herniæ in accordance with the condition in which their contents are found. Thus, if they can be restored to the abdomen at pleasure, the hernia is said to be *reducible;* if this is not possible, it is said to be *irreducible;* and when, from any cause, an irreducible hernia is so constricted as to impede or prevent the passage of the feces and the circulation of the blood in the tumor, it is spoken of as *strangulated.* When a hernia has existed from birth, it is designated as *congenital hernia.*

Another class of herniæ, usually designated as **Umbilical**, presents a variety which, though often supposed to be due to the passage of the viscera through the opening left by the umbilical vessels of the fœtus, seldom if ever is so. This variety of hernia, from having been rather loosely described by writers, is liable to mislead such as do not carefully attend to the normal relations of the part, the fact being that a hernia seldom escapes by the umbilicus proper. In the fœtus, a perfect opening exists in this portion of the abdominal parietes, which is correctly designated as the umbilicus, through which the vessels of the cord are transmitted; and while the latter exist, or shortly afterward, a hernia may pass directly along the course of these vessels, but in the adult it is otherwise. At the latter period, the former aperture is so closely contracted, and the vessels which occupied it so perfectly solidified, that this point offers greater resistance than the linea alba itself, and a hernia through the umbilicus proper in an adult is, therefore, almost impossible. An examination of the linea alba shows, however, even in the normal condition, at many points, but especially in the neighborhood of the former umbilical opening, a weakness of the structure around the course of the vessels, as well as a number of minute orifices in the tendinous parietes, which give exit to small cutaneous blood-vessels and nerves. When, therefore, one or more of these openings have yielded to the relaxation consequent on pregnancies, or to such other causes as produce distention of the part, the tumor, when formed, may be designated as an umbilical hernia, because occurring in the neighborhood of the umbilicus.

Pathological Changes in Herniæ.—When the escape of a hernia from the abdominal cavity has caused a protrusion of the peritoneum, and formed what has been termed the sac, the effects of the complaint will vary according to circumstances. Thus, if the protrusion has been gradual, there will generally be seen an elongation of all the tissues in front of it; while if the rupture has been the result of a sudden effort, or of direct violence, it may lacerate one or more of them, and pass directly through. The majority of cases of herniæ being produced by the application of forces which are continued for a longer or shorter period, most of the tissues connected with the seat of the tumor are elongated rather than torn, and acquire a peculiar pouch-like form, especially the peritoneum, which is for this reason called the **Sac.** In order to distinguish the different points of this sac, it has been divided

PLATE XLI.

SURGICAL ANATOMY OF THE PARTS CONCERNED IN HERNIÆ.

Fig. 1. A sketch of the Exterior of the Abdomen, showing the general outline of the muscles, as well as the general points of reference required in operations upon this region. 1. The umbilicus. 2. Hypogastric region. 3. A line drawn from the anterior-superior spinous process of the ilium to the umbilicus, and crossing the course of the epigastric artery. At one period, the puncture in ascites was advised to be made in this line, but it was given up, owing to the risk of wounding the artery. *After Bernard and Huette.*

Fig. 2. The same parts, as shown after the removal of the skin, fat, and superficial fascia by a careful dissection. 1, 1. The linea alba. 2, 2. Rectus abdominis muscle, and lineæ transversæ. 3. External oblique. 4. Its tendon, also the position of the internal abdominal ring. 5. Round ligament of the uterus at its exit from the external abdominal ring. 6. Epigastric artery. 7. Peritoneum covering the intestines. 8. A section of the fascia transversalis everted. 9. Transversalis abdominis muscle. 10. Internal oblique muscle. 11. External oblique. 12. Section of the rectus. *After Bernard and Huette.*

Fig. 3. A view of the Superficial Fascia of the Abdomen and Thigh, as shown by a careful dissection of the skin. 1, 1. The fascia superficialis, arising on the thigh and extending over the abdomen as one continuous layer. 2, 2. Branches of the arteria ad cutem abdominis. 3, 3. Branches of the corresponding superficial veins. *After Bernard and Huette.*

Fig. 4. Another view of the same, as seen after a closer dissection, but especially in its relations to femoral herniæ. 1. Fascia superficialis. 2. Perforations in the superficial fascia of the thigh, for the passage of the superficial vessels. 3, 3. Extension of the superficial fascia over the cord and testicles. 4, 4. Superficial arteries. *After Bernard and Huette.*

Plate 41.

Fig. [illegible]

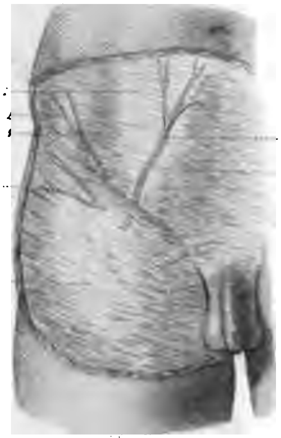
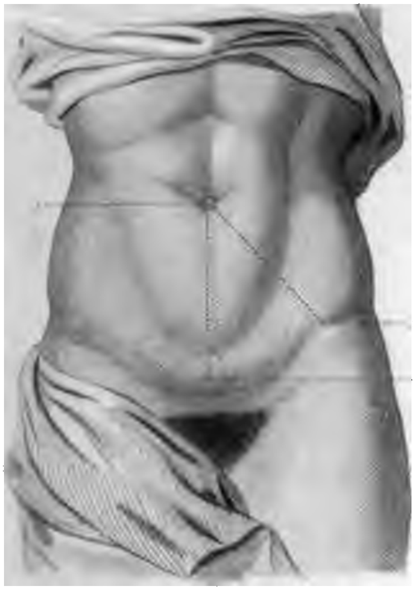


Fig. 1



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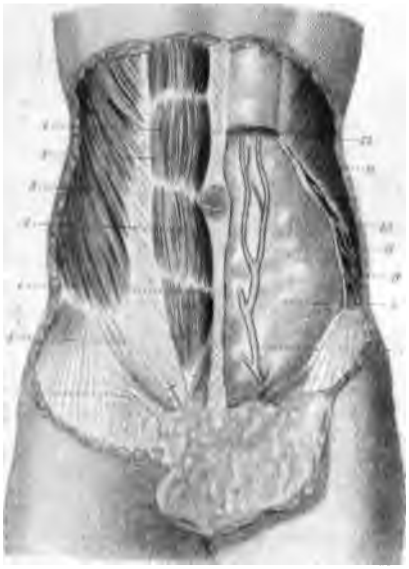

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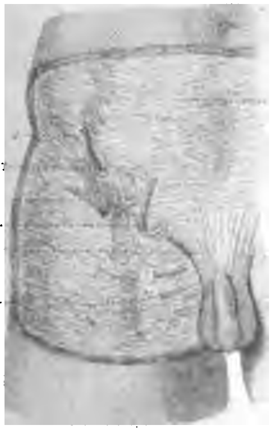


into different regions, so as to enable writers to define more accurately the part to which reference is made: thus its **Mouth** is the portion which is continuous with the abdomen; the **Neck** that which adjoins the opening in the abdominal parietes, through which it protrudes; while its **Body** is the main cavity, and the **Fundus** its interior portion, or that which is most distant from the abdomen. But though these names generally indicate the regions of the sac, and therefore to a certain extent its outline, they are not universally applicable. Sometimes there are two distinct sacs, or the body of one sac is contracted in the middle, so as to present a kind of hour-glass contraction, and create two necks, or two bodies, as may be seen by reference to the plates connected with this subject. Under ordinary circumstances, when a sac has been formed, it is possible, if the patient is seen immediately after its protrusion, to replace both it and its contents in the abdominal cavity. A little later the contents may be returned; but the external surface of the sac, having contracted adhesions to the extra-peritoneal fascia, (**Fascia Propria,**) the sac remains, (**Reducible Herniæ**). Sometimes both the sac and its contents contract adhesions and are permanently fixed, (**Irreducible Herniæ,**) or the contents may be so constricted as to arrest the circulation, and lead to the development of a certain train of symptoms designated as those of **Strangulated Herniæ.** It is for the relief of the latter that the operation of herniotomy, as it is sometimes termed, or the incision of the parts around the protrusion, is demanded; before proceeding to the details of which, it will prove useful to refer to the general symptoms connected with herniæ as most frequently noticed.

Reducible Herniæ.—All herniæ, whether reducible, irreducible, or strangulated, are composed either of intestine or of omentum, or of both, and give rise to tumors which vary in shape, size, and position. When the tumor can be restored simply by the taxis, it constitutes the variety of the complaint which is designated as a **Reducible Hernia.**

Symptoms.—The symptoms of a reducible hernia are as follows: There is a tumor in the abdominal parietes or on the thigh, which is well marked while the patient is standing up, but which disappears when he lies down, and to which coughing generally communicates a distinct impulse, as may be felt by placing the hand upon the tumor and directing the patient to cough, when the movement will be readily noted.

The tumor caused by a hernia is also very apt to be larger after a full meal than at any other time, and the patient experiences more or less of the evils of flatulence, as *borborygmi* or grumblings and roarings in the bowels, particularly in the neighborhood of the tumor, these being caused by the difficulty experienced by the flatus in passing through the protruded portion of the intestines.

The hernial tumor generally commences above and extends downward, and, if it attains any size, is more or less pendulous in its character; the size attained finally being in some cases truly immense, reaching, in cases of scrotal or umbilical hernia, almost to the knees of the patient. Herniæ may, therefore, at any time be rendered irreducible from blows upon the tumor, or pressure upon the neck of the sac, by improper manipulation, such as the application of a truss when the tumor is not properly reduced; or from too great an amount of violence in making taxis. Every irreducible hernia is usually reducible in the first instance, and those which are found irreducible are, therefore, generally of some weeks' or months' standing.

When the contents of a hernia are chiefly **Intestine**, the tumor will be elastic and springy, especially when the patient coughs. Gurgling is also heard at the moment of reduction, and the rumbling of flatus may occasionally be felt in the tumor.

When the contents are **Omentum**, the tumor has a more doughy feel, gives a less distinct succussion to the finger when the patient coughs, creates no rumbling, and is less painful.

Diagnosis.—The diagnosis of each variety will be given hereafter.

Prognosis.—Reducible herniæ may exist for years and not destroy life, and, beyond the mere inconvenience of bulk, do not seriously trouble the patient. But so long as a hernia exists, and is not properly kept up within the cavity of the abdomen, so long is the patient exposed to strangulation and sudden death, living as if the sword of Damocles were constantly suspended over him, ready to fall without a moment's warning.

Treatment.—The general treatment consists in reducing the hernia, and keeping it within the abdominal walls, as hereafter mentioned.

In reducible herniæ, the tumors containing intestine are generally much more readily replaced than those containing omentum, as the constriction at the neck of the sac, which is always more or less present, interferes so rapidly with the circulation in the omentum, that effusions take place, and it soon becomes very difficult to replace it in the abdomen.

Another change which takes place, commonly after a very short time, even in the reducible herniæ, is the contraction of adhesions between the hernial sac and the surrounding parts, so that although the intestine can readily be passed up into the abdomen, the sac itself still remains outside. In this case, after the surgeon has reduced any intestine or omentum which the sac may contain, further manipulation can be of no service, and may do harm by bruising the sac and exciting an inflammation in it that may create sloughing. After the hernia is reduced, however, it has been recommended, by many, to keep up a steady though moderate pressure for some time upon the neck of the sac, and it has been asserted that adhesive inflammation has thus been produced, and the opposite edges of the mouth of the sac so glued together that a hernia could no longer come down, a radical cure being thus effected; but surgeons differ in opinion in regard to the possibility of such cures being radical; my own personal observation being decidedly adverse to its practicability in the great majority of instances, except in children.

Symptoms of Irreducible Herniæ.—The tumor caused by this class of herniæ is more or less permanent, varying in size and symptoms according to circumstances; thus constipation, flatulency, the erect posture, corpulency, or pregnancy, may increase it, by filling the cavity of the bowels, or by obstructing the circulation and giving rise to infiltration of the omentum, these conditions being shown at the time by the pain and other symptoms detailed in connection with the reducible class. But colic is more common in the irreducible herniæ than it is in the reducible class, on account of the greater tendency of feculent matter to lodge in the protruded intestine. The patient is also more apt to suffer from attacks of nausea and vomiting, in consequence of the fixed position of the omentum or intestine interfering with the distention and upward movements of the stomach, especially after a full meal. Irreducible herniæ may also give rise to symptoms which are the result of injury to the contents of the tumor by external causes, as well as to those which will be hereafter detailed as the result of strangulation.

SECTION II.

STRANGULATED HERNIÆ.

When, from any circumstances, a reducible or irreducible hernia is constricted by the surrounding structures to such a degree as to interfere with the passage of the contents of the bowels through it, or when the circulation becomes interrupted either in the bowel or in the omentum, a certain class of symptoms are induced which are regarded as positive evidence of the existence of strangulation or constriction.

Etiology.—Strangulation may be caused, in an irreducible hernia, either in consequence of a sudden protrusion of intestine through a small aperture, from the distention of the part by accumulations of flatus, feces, or blood, from swelling of the narrow portion (neck) of the sac, from spasm of the parts around it, or from the formation of bands at its mouth as the result of inflammation.

Symptoms of Strangulated Herniæ.—The symptoms of strangulated herniæ will be found to vary with the tightness of the constriction and the length of time that it has continued. They will also vary when the strangulation results from obstruction to the passage of matter through the protruded part, and when it is the result of inflammation.

When the consequence of simple obstruction, the patient experiences a sense of uneasiness, fullness, or constriction in the part or in the abdomen, as if a cord was drawn around the latter, accompanied by flatulence, more or less violent colicky pains, a desire to go to stool or to strain, but without any or at least slight evacuations. This is followed by nausea and vomiting of the contents of the stomach, then of mucus and bile, and subsequently by distressing retching, restlessness, moisture of the skin, irritation and excitement of the pulse, and the other usual symptoms of a bad attack of colic. If promptly relieved by a reduction of the tumor, these symptoms will all disappear, the patient obtain immediate relief, and have a free evacuation of the bowels; though there may remain a certain amount of soreness of the region, or even of the whole abdomen. But if the obstruction remains, and inflammation is induced, then the symptoms just detailed will be followed by others of a more serious character. In some cases of strangulation, these violent symptoms may be the first indications given of the existence of constriction, patients often suffering from some of those just detailed without deeming them more than the ordinary inconvenience likely to result, or which has previously resulted, from their complaint.

The symptoms of strangulation, in very marked cases, consist in a greater tension and tenderness of the tumor; in increased tenderness and swelling of the abdomen; in increased vomiting, which finally brings up stercoraceous matter, accompanied or followed by hiccough, and in a change in the color of the tumor, which becomes dark red or livid, and gives a doughy or crackling sensation to the touch. The pulse becomes more frequent, small, and wiry; the skin more wet, cold, and sodden; the countenance expressive of distress and suffering; the mind desponding and anxious, though presenting occasionally intervals of apparent relief, till at last the suffering ceases; the patient is apparently easy, though very feeble; the pulse fails; respiration becomes short and labored, and death closes the scene.

Diagnosis.—There are several conditions with which strangulated herniæ may be confounded, and from which it is important to distinguish it. Of these, that for which it is most likely to be mistaken is *ilius* or *intussuscep-*

PLATE XLII.

A VIEW OF SOME OF THE PARTS CONCERNED IN INGUINAL AND FEMORAL HERNIÆ.

Fig. 1. Surgical relations of the Blood-vessels in Inguinal and Femoral Herniæ. 1. Skin, fascia, external oblique, internal oblique, and transversalis muscles incised. 2. Fascia transversalis and peritoneum covering the intestines. 3. Position of internal inguinal ring. 4. Epigastric vessels. 5. Section of rectus abdominis. 6. Tendon of external oblique, or Poupart's ligament. 7. Fascia lata femoris. 8. Femoral artery. 9. Femoral vein. 10. Sheath of vessels. 11. Saphena vein. *After Bernard and Huette.*

Fig. 2. Envelopes of an oblique Inguinal Hernia. 1. Skin and superficial fascia. 2. Tendon of external oblique distended by the hernia. 3. Cremaster and tunica vaginalis communis, or the fascia propria of the hernia. 4. Sac. 5. Omentum. 6. Intestine. *After Bernard and Huette.*

Fig. 3. View of a direct Inguinal or a Ventro-Inguinal Hernia. 1. Integuments of abdomen. 2. Tendon of external oblique. 3. Fascia transversalis and peritoneum. 4. Spermatic cord. 5. Sac laid open. 6. Position of epigastric artery in this variety of hernia. 7. Intestine. 8. Position of the crural ring. 9. Saphena vein. 10. Saphenous opening of fascia lata.
After Bernard and Huette.

Fig. 4. Plan to show the relation of the parts of the Sac. 1. Abdominal parietes and ring. 2. Neck of sac. 3. Its fundus. 4. Its mouth. 5. Peritoneal cavity. *After Bernard and Huette.*

Fig. 5. Peculiar form of a Sac, as occasionally seen. 1. Abdominal parietes and ring. 2. Fundus of sac. 3. Body of the sac above an hour-glass contraction. 4. Cavity of the peritoneum. *After Bernard and Huette.*

Fig. 6. Commencement of the changes seen in the formation of a Hernial Sac. 1. Abdominal parietes. 2, 2. Knuckle of intestine protruding at the ring, and forcing the peritoneum before it so as to form the sac. 3. Fundus of sac.
After Bernard and Huette.

Fig. 7. Next step of the formation, as seen in a recent Hernia. 2. Abdominal ring. 2. Intestine as protruding and constricted by the ring.
After Bernard and Huette.

Fig. 8. A view of the parts, as seen in a more advanced Hernia. 1. Abdominal parietes. 2, 2, 2. Intestine. 3, 3, 3. Continuous line of peritoneum.
After Bernard and Huette.

Plate 42

Fig. 1.

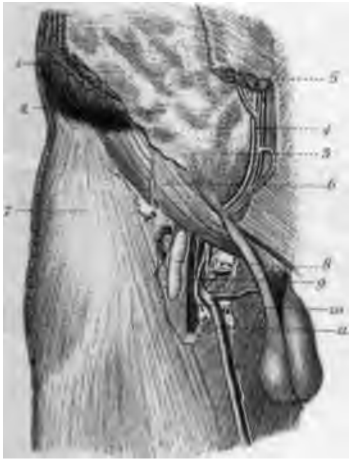


Fig. 2.

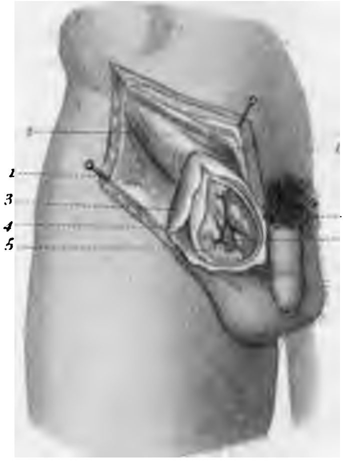
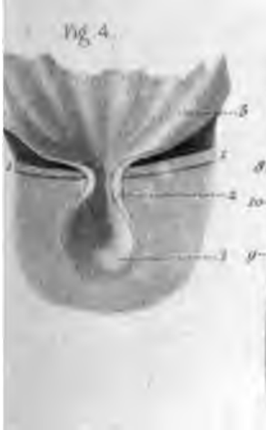


Fig. 3.

Fig. 4.



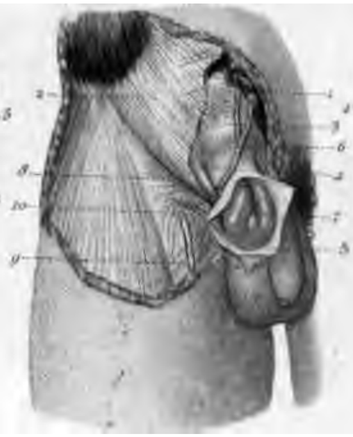


Fig. 5.

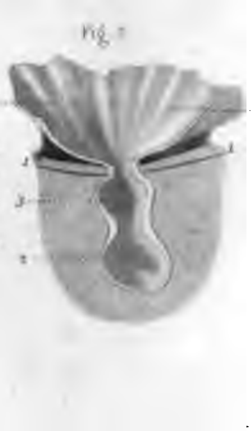


Fig. 6.

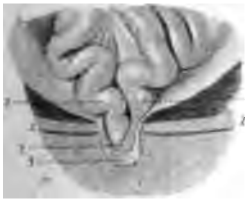


Fig. 7

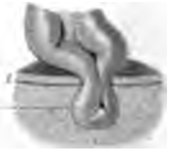
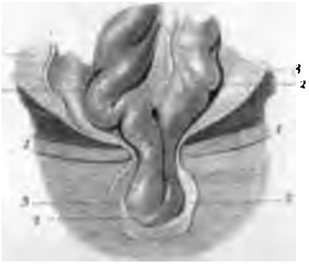


Fig. 8



tion, or the train of symptoms not unlike those of strangulated hernia, such as pain, constipation, stercoraceous vomiting, etc., which ensue when a portion of the intestine is invaginated within itself, so as to create a diminution of its calibre, or a continued spasm of its muscular walls, so as to obstruct the passage of the fecal matter toward the anus.

But although the general symptoms in these cases are similar to those of hernia, yet a diagnosis can often be made with facility; because in hernia a careful examination will always show a tumor, while even in those cases which, from the difficulty of recognizing the tumor, have been named *concealed herniæ*, the tumor may be found with more or less readiness by etherizing the patient and examining him carefully, when he is fully relaxed by the influence of the anæsthetic. The history of the case will also materially aid the diagnosis; and if the patient be old enough or intelligent enough to give one, will generally leave no doubt as to the true state of the bowels.

Pathology of Strangulated Herniæ.—When, as a consequence of strangulated hernia, the patient dies, the *post-mortem* appearances are very marked, the tumor itself usually exhibiting all the symptoms of mortification of a portion of the intestine. The latter, therefore, will be observed to be of a brown or chocolate color, resembling in this respect the color already described as belonging to moist gangrene. The hernial sac also usually presents a greater or less quantity of serum, which is generally tinged of a deep chocolate color by the altered hæmatin that has been effused as the result of the congestion that follows the constriction of delicate and vascular tissues.

Prognosis.—The prognosis in strangulated herniæ is always serious, and should be guarded, death being apt to ensue if the strangulation is not relieved by an operation, while the operation itself if delayed is frequently unsuccessful. Still, cases occur in which, as has been already stated, the patient will survive the strangulation without an operation in consequence of the formation of an artificial anus. As regards the prognosis of the different forms of strangulated herniæ, it should be remembered that small herniæ are more frequently the cause of death than those of greater bulk, because, perhaps, they are more frequently overlooked or trifled with, and also because large tumors dilate the parts to such an extent that the strangulation is not so complete, and therefore by no means so serious as is the case in the small protrusions. The prognosis of intestinal herniæ, when strangulated, is much more unfavorable than that of strangulated omentum, as might readily be imagined, because in the latter the calibre of the intestine is not involved and the passage of the feces not interfered with, the risk in omental cases being chiefly from the development of peritoneal inflammation. The time in which death may occur from strangulated hernia is various; thus it may happen in twenty-four hours, though, as a general rule, it will not take place until sufficient time has elapsed to permit the patient to pass through the symptoms above detailed, while very frequently to these will be added the more tedious symptoms of general peritonitis, this being not uncommonly the cause of death. The duration of strangulated herniæ varies from one to ten days.

Treatment.—The treatment of this variety, when not demanding herniotomy, will be given under the section on the reduction of a hernia, strangulation ceasing as soon as the contents are properly replaced.

SECTION III.

TREATMENT OF HERNIÆ.

The symptoms of the varieties of herniæ just detailed having shown that the dangers, though imminent, depend to some extent upon the existence of strangulation, or on the period during which the protruded part has remained constricted, it is evident that the whole treatment of this disorder must be resolved into either a prevention or removal of this constriction.

In every case, therefore, it becomes the surgeon's duty to attempt the restoration of the contents of the tumor at as early a period as possible, bearing in mind, in all efforts, the great liability of the protruded parts to be bruised or injured by pressure, as well as the possibility of lacerating, in certain cases of strangulation, such portions as are in a state of softening or mortification.

§ 1.—**Reduction of Herniae.**

The manual treatment requisite for the reduction of herniæ is designated by the term *Taxis*—*ταςςω*, to arrange—this word signifying the replacing of the contents of the tumor in the abdominal cavity.

General Plan employed in practicing Taxis.—The details of the taxis, as required by each form of hernia, being hereafter given, this account will be restricted to such means as are applicable as adjuvants to the taxis in all cases. To perform the taxis with success, it is desirable that the parts constricting the tumor, as well as the muscular system generally, should be placed in as perfect a condition of relaxation as possible, both by the position of the patient and by constitutional measures, and that the pressure of the fingers should be made in the axis of the tumor, unless its peculiar position requires some slight modification of the rule, as will be shown in connection with the special cases. At present, the general or constitutional treatment likely to facilitate the reduction of all herniæ, where difficulty is experienced, can alone claim attention.

The earliest causes of difficulty in the reduction of most herniæ being the accumulation of either fecal, gaseous, or vascular secretions within the protruded portion, the first point to be attended to is, to empty the bowels by enemata, and relieve the stomach by emetics, especially if a full meal has preceded the difficulty, in order that a freer circulation may be established in the protruding portion. At the same time, the bladder should be voided of its contents, in order to give as much room as possible within the cavity of the abdomen.

If, in any hernia, the constriction is supposed to be the result of muscular contraction, perfect relaxation of the whole system should be produced, and the patient placed in such a condition as will tranquilize the action of the diaphragm and respiratory muscles. To accomplish this, nothing is comparable to perfect etherization, especially in the hernia of children, as these patients, when etherized, always lie perfectly quiescent, and have a respiratory movement of so slight a kind—compared with the efforts which they usually make to resist the taxis, either in consequence of pain or fear—that the facility of the reduction is much increased. Indeed, a resort to ether is often sufficient, of itself, to accomplish the reduction of herniæ in the adult without the use of nauseants, the warm bath, or any of the other means usually employed; but the entire evacuation of the contents of the stomach should always precede the employment of the anæsthetic. Should the want of ether prevent a resort to this powerful adjuvant to the taxis, then the practitioner must employ some of the other means of inducing the same degree of muscular relaxation, such as the warm or hot bath, or the administration of tobacco or tartar emetic. The employment of tobacco, in the form of infusion, in the proportion of a drachm to the pint of water, one-third or one-half of which is thrown into the rectum every hour, is a very powerful means of inducing general relaxation, but is liable to the objection of exciting a longer and more thorough depression of the system than is desired, in consequence of the continued absorption of the infusion if the rectum does not expel it, as will sometimes happen in consequence of the relaxation of its muscular coat, even though the sphincter ani muscle offers no impediment to its escape. A much safer and more controllable method of applying tobacco will be found in the following plan :—

Macerate a drachm of tobacco for a few minutes in a sufficient quantity of hot water to soften it; then tie the mass up in a bag made of a small piece of gauze (bobbinet) previously soaked in water, and leave the end of the string that is tied around the mouth of the bag attached to it. Push the bag into the rectum like a suppository, and when a sufficient constitutional effect is induced, draw it out by means of the string which has been left pendulous at the anus.

Various local means have also been recommended as adjuvants to the taxis, such as warm applications to relax the cause of the constriction, or cold articles to favor the contraction of the protruded portion; but as the three principal varieties of hernia escape most frequently through aponeurotic openings, which are attached to muscular fibres, little or no relaxation near the seat of stricture can be anticipated from the application of heat, while by causing an afflux of blood to the part, it must tend to increase the local congestion in the vessels of the tumor, especially if omentum constitutes a part of it. Cold, on the contrary, will diminish this congestion, and reduce the size of the protruding tissues, by exciting contraction of the fibres of the cremaster muscle, or peristaltic action in the muscular coat of the bowel, so as to favor the reduction of the tumor, while it cannot affect the condition of a tissue so purely fibrous in its character as that found in the usual position of the hernial rings. In applying cold as a means of restoring hernial protrusion, or as an adjuvant to the taxis, it will be found most useful when its action is limited to the contents of the tumor. To effect this, apply it as follows: Take a cold cloth or small lump of ice and apply it *directly to the lowest portion of the tumor*, without permitting it to touch the upper portion, or that near the neck of the sac, so that it may induce a contraction of the contents of the sac from below upward, when, if the case is one of scrotal or inguinal hernia, the effect will be promptly noticed, the scrotum and fibres of the cremaster muscle contracting so rapidly as to render the change in the position of the tumor very apparent. If the hernia contains intestine, the cold thus applied, by hastening the peristaltic movement, will also tend to empty the bowel of its contents or of its blood, thus diminishing its size, and aiding very materially in its restoration. When the cold is applied to the largest portion of the tumor, or a lump of ice is so placed upon it that its weight may aid the effect of the cold, or when it is indiscriminately applied all over the tumor, it is liable to produce contraction of the muscular parietes of the abdomen, and by thus constricting the parts near the mouth of the sac, to do more harm than good.

When a hernia has been reduced, a good truss should be well adjusted to the opening—in the manner hereafter directed in the special forms of hernia—in order to prevent future protrusions.

If, in strangulated herniæ, the efforts at taxis do not succeed, then there will be a necessity for resorting promptly to herniotomy for the purpose of relieving the constricted bowel and preventing mortification, as this operation is not near so dangerous as the taxis, when rudely or improperly practiced or continued for too long a time. It is important, therefore, in this form of hernia, that the taxis should be of the gentlest kind, so as to diminish as much as possible the danger from bruising and inflaming the intestine, and that herniotomy should be early resorted to, in order that there may be as little time for the strangulated portion to become inflamed and mortified.

So frequently has this been noted, that Desault, in the Hôtel-Dieu of Paris, would not permit the young residents of his hospital to touch a case of strangulated hernia until he saw it himself, and then, if the hernia was not reducible on the gentlest taxis, he proceeded **at once** to the operation. Statistics clearly show that by such a course fewer lives are lost than when more violent efforts at taxis are made before resorting to the operation. A similar result coincides with the experience of most operators, and cannot be too strongly impressed on the mind of every physician, the surgeon not being sent for, in many instances, until the progress of mortification has rendered an operation necessarily unsuccessful.

§ 2.—Palliative Treatment of Reducible Herniae.

The removal of the weight of the intestines from a hernial tumor having enabled its contents to return to the cavity of the abdomen, as frequently happens when the patient takes the horizontal position, or when pressure is made on its contents in order to replace them in the abdomen, as in the operation of taxis, their future descent should be prevented by resorting to some of the bandages capable of making constant pressure at the point of exit.

These bandages are very varied, and, under the name of **Trusses,** have received every possible modification in the means of attaching them to the part, composition of the pad, or variety of adaptation to particular seats of hernia. From a very early period, the form of a truss best adapted to the treatment of hernia has been governed by the peculiar views of the surgeon at the moment, or by other accidental circumstances. As the manufacture of these bandages has also led many unprofessional men to study the complaint superficially, great ignorance, and often a want of common honesty, have been exhibited in the formation and laudation of such instruments as it is apparent cannot possibly accomplish the object that is desired, namely, the perfect retention of a hernia within the abdominal walls. In the United States, the variety in the instruments recommended for this retention has been fully equal to, if it has not exceeded, that found in Europe, and it would be a useless labor to attempt either an enumeration of the different kinds or an examination of their merits and defects. Nearly all trusses are liable to the serious professional objection of being patented, in consequence of which an unnecessary cost is charged upon those who require them. I am therefore unwilling, in a professional treatise, to specify any one truss as being a better or more scientific instrument than another, lest improper advantage be taken of the recommendation, and shall now merely state the general character of a good truss.

A good truss is an instrument formed of a spring of sufficient elasticity to retain a **pad** at the seat of the hernial protrusion, and resist the action of the diaphragm and abdominal muscles. To prevent its chafing the skin, it should be very smooth, as polished bone or wood. Those covered with soft leather absorb moisture and soon become harsh and rough. When a truss is well fitted to the patient's pelvis, it will not require straps to prevent the instrument from slipping upward when once placed in a proper position.

In order to adapt a truss to a patient, the surgeon should pass a piece of tape or soft wire directly around the pelvis at the seat of the protrusion, and, allowing one additional inch for the covering of the spring and thickness of the pad, select an instrument of the length of the string or wire.

The spring of a truss will be strong enough when it will press firmly on the orifice through which the hernia escapes, and yet does not cause the pad to indent the tissues after it has been worn a few hours. If it does more than this, the spring is too strong, and will do harm by inducing atrophy of the structures; if the pad is incorrectly shaped, it will favor the recurrence of the hernia when the truss is omitted, by enlarging the rings.

The pad of a truss, being the most important part, has generally received marked attention, and been made of every conceivable shape and material; some being round, oval, oblong, pyriform, pyramidal, conical, truncated, and square, and composed of uncovered cork, wood, ivory, metal, glass, or of wire springs, or of horse-hair covered by kid, buckskin, leather, caoutchouc, linen, or cloth. A good pad should have the following characters: A perfect anatomical adaptation to the shape of the region that it is to cover; sufficient firmness to maintain its proper surface without variation; and be either composed of, or covered with, some substance that is capable of preventing irritation of the skin or its excoriation from the constant absorption of the perspiration.

When a patient desires to bathe, a similar truss covered with oil silk may be employed, or an oil silk sheath be slipped over the truss as usually worn. The pad should generally be permanently attached to the end of the spring, or be so fastened by screws that it can be shifted only by the use of a screw-driver. The much lauded "movable," "self-adjusting," "self-regulating," "ball-and-socket" trusses I regard as among the follies of the day, and worse than useless. Every pad should have its surface so beveled as to adapt it to the natural inclination of the abdominal or femoral parietes; or, if the patient is very corpulent, the pad should be so inclined upon the end of the spring as to enable it to press gently from below upward. With the knowledge possessed by every reputable cutler in the United States, any surgeon can have a proper truss constructed for each case as it is wanted, and it is to be hoped that the profession, by pursuing this plan generally, and giving their attention to the subject, will be able to do away with the practice of employing such instruments as are patented and sold by "bandage makers." The common hair stuffed pads, so often sold by druggists, etc., for the treatment of hernia, have two serious objections: 1st, the hair yields to the pressure, and the pad loses its proper shape; and 2d, the pad and its covering, by absorbing perspiration, often become exceedingly foul and irritating, developing eczema of the skin, and requiring the truss to be laid aside.

Fitting of Trusses.—To apply a truss accurately to the retention of an inguinal hernia, the patient should be first placed in the position for the taxis, and the entire contents of the tumor restored to the cavity of the abdomen; then, while a finger is applied at the internal ring in an "oblique inguinal hernia," or at the external ring in a "direct hernia," place the pad at this point by slipping the spring under the patient's back and around the pelvis, fasten the circular strap, and, letting the patient rise, notice whether any portion of the hernia escapes by the side of the pad. If it does not, direct the patient to move about a little and cough, so as to see if the pad retains its place, or whether it is disposed to slide up, as is sometimes the case. If it does, then apply the perineal strap to hold it down; but otherwise it will not be required. Some caution is also necessary in applying a truss to the male, lest the pad be so shaped or so placed as to touch the pubis and compress the cord, thus exposing the patient to the danger of having one testicle atrophied. Except in a direct inguinal hernia, there is no occasion for a pad to touch the pubis; on the contrary, it should close the internal rather than the external ring. In the direct variety, or the more rare form of inguinal hernia, as the external ring must be the point for the pressure, the pad should be always so rounded or curved on its inferior edge that, while it approaches the pubis, it shall not be able to compress the cord against it.

In employing a truss for the retention of a hernia, surgeons have experienced the following evils, which may occasionally result from the use of this instrument: thus, if a portion of the hernia escapes and is compressed by the truss, the patient will be exposed to the risks of strangulation; if it presses very firmly on the rings, it may lead to absorption of the adipose and areolar tissue around them; if it produces excoriation of the skin, it may necessitate the removal of the instrument, and do away with the possibility of making any pressure, while if it compresses the spermatic cord against the pubis, it will induce the atrophy of the testicle just referred to.

A truss that is well made and properly applied will, however, be free from these objections. It may be said to be well applied if the patient feels comfortable under all movements, and has the sensation of increased strength in the part, and it will be well made if its spring is strong enough to support the hernia, without making such pressure as would indicate the position of the pad by the indentation left on the skin after the truss has been removed. Nor should a truss, as a general rule, be applied with the idea of inducing adhesive inflammation in the subjacent structures. Its object is mainly that of a supporter, which, by preventing the descent of the bowel into the inguinal canal, affords an opportunity to the tissues to contract toward their original condition. A truss that possesses the characters that I have detailed, and which is constantly worn night and day, will render a patient perfectly secure from strangulation, and though I believe it will be unable, in most adult cases, to cure a hernia radically, it yet presents us with the following advantages: 1st. The pad may be readily and accurately shaped to meet the anatomical relations of the region. 2d. From its being formed of firm materials, its shape is never changed, as is the case in trusses with soft pads. 3d. Screws upon the neck, by fastening the pad of the instrument to the spring, except when shifted by a screw-driver, materially facilitate its accurate adjustment to the part, and insure the safety of adjacent blood-vessels. But in choosing any instrument, the surgeon should be especially observant of the force of the spring; generally they are too stiff, the cutlers having no idea except that of sufficient force "to push up the bowel," whereas a good instrument should have only sufficient power in the spring to prevent the descent of the contents of hernia, after it has been replaced either by the fingers of the patient or of the surgeon. If a spring seems to be too stiff, its power may be diminished by gently bending it backward, or from its natural curve, care being taken to apply the pressure near the neck of the instrument, and not to carry it so far backward as to break the spring.

The selection of a truss is a subject that deserves, and has received, careful attention from a large number of surgeons, and whether we entertain a high opinion of its efficacy in effecting a radical cure, or only believe in its utility in the palliative treatment of this complaint, it should be well made and accurately fitted, or it will do neither.

In treating a hernia by a truss, I would advise, under any circumstances, that the instrument should be applied in every case except in children under eighteen months, as the patient is only safe from the dangers of strangulation while wearing one. When a truss is once applied, the patient should also be directed to wear it constantly, and cautioned against taking it off at night, lest he suffer from sudden strangulation, such as I once saw in a patient who, having removed his truss on going to bed, was attacked with strangulated hernia during sexual intercourse.

CHAPTER IV.

ON THE RADICAL CURE OF HERNIÆ.

ALTHOUGH after the reduction of a hernia and the application of a good truss, the patient is for the time secure from the dangers of strangulation, yet his liability to omit the use of the instrument, as well as the inconvenience which sometimes ensues upon its employment, has frequently induced surgeons to search for some means of closing the openings or rings, so as to secure him permanently against the recurrence of the complaint. These means have, of course, been very varied, though generally predicated on the development of such an inflammatory action in the part as would create adhesions of the sides of the opening, or plug up the orifice, through which the hernia escaped, by such articles as would remain in consequence of their fusion with the structures around the rings. Reserving an opinion of the value of these plans of treatment until they have been enumerated, I shall now present a brief account of a few of such American and European suggestions as seem plausible or have been attended with some success.

Operation of Gerdy, of Paris, practiced in 1837. — A curved needle, pierced with an eye near its point, and fastened to a handle, several quills for the quilled suture, some strong aqua ammonia, together with ligatures and a camel-hair pencil, being prepared, the operation is thus performed :—

"While the patient is lying down, the surgeon places his left forefinger under the anterior edge of the scrotum, pushes back the skin from below upward into the ring, and as far as possible into the inguinal canal, leaving the spermatic cord behind. The needle, armed with a double thread, is then directed on the finger to the bottom of this blind pouch, and its end brought out in front, so as to traverse, at the same time, the reflected portion of the skin, the front of the canal, and the skin of the abdomen. As soon as the eye, near the point of the needle, is seen outside, one end of the ligature is disengaged and kept outside, while the other end is withdrawn with the needle, Plate XLIV. Fig. 1. Being then pushed through the same tissues, it is brought out half an inch from its first point of issue, Plate XLIV. Fig. 2, and the second end disengaged in the same way. The pouch, formed of the skin of the scrotum, being now retained by a loop of thread in the canal where it was pushed by the finger, the threads of one side are tied on a quill half an inch long, and the other threads on another tube so as to form the first point of a quilled suture, Plate XLIV. Fig. 3. Two other points of suture being made in the same way, one on the inside the other on the outside, at half an inch distance from the first, a camel-hair pencil should be dipped in the ammonia, and the scrotal skin in the pouch cauterized sufficiently to destroy its epidermis. Inflammation attacking this skin, the two surfaces which are in contact suppurate, and adhere about the eighth day, when the threads are removed and the canal obliterated."

The other plans of treatment are very varied: thus, Velpeau, at one period, revived the old plan of scarifying the sac, but has since abandoned it; and Belmas introduced strips or bags of gelatin into the cavity of the sac, though it proved to be a very imperfect plan of proceeding. Bonnet, of Lyons, and Mayor, have also attempted the constriction of the canal by pins and ligatures—as in cases of varicocele—but have obtained only occasional and temporary success.

The following operation is among the more recent of those proposed, and presents some points which are worthy of notice:—

Operation of T. Wood, of Cincinnati.—Having prepared a needle, with the eye in the middle and a spear-point at each end so as to enable it to pass readily in any direction without becoming entangled, place the patient on his back in bed, with the pelvis elevated, so as to relax the tension of the abdominal parietes. The hernial sac with all its contents being then returned through the ring, pass the little finger of the left hand into the ring so as to carry before it the thin structure of the scrotum. After thus ascertaining the condition of the ring, and being satisfied that there is nothing between its columns but the spermatic cord, carry the latter downward and inward, and hold it by the pressure of the finger in the angle of the ring, which is next to the symphysis pubis, and, while it is thus retained, thrust the point of the needle through the integuments so as to strike the inner column of the ring about one-eighth of an inch from its margin, and as near the pubes as is possible without endangering the cord, either by wounding it with the needle or by constricting it, when the sides of the ring are approximated by the ligature. The point of the needle being then passed through the tendon in many points, so as to excite more action, and carefully directed upward, pass it through and across the canal—so as to avoid the cord, and also prevent its becoming entangled in that portion of the scrotum which caps the finger—until it reaches the opposite column of the ring at a similar distance from its margin, when, the side of the needle being pressed strongly against the abdominal ring, the finger should be gradually withdrawn until the point of the needle can be made to reach a proper point for puncturing the tendon, when it should be thrust through and made to appear on the external surface of the integuments opposite its point of entrance. The point of the needle being now seized, and drawn carefully through until the ligature has passed through both the punctured columns of the ring, make it retrace its course as soon as its eye escapes from the tendon, so as to carry the end of the ligature through and out of the first opening made in the skin, thus placing the first end of the ligature at the puncture first made, and the last end at the opening made by the exit of the needle; after which the two ends should be tied over a compress placed between them, so as to bring the opposite columns of the ring in contact and cause their union by adhesive inflammation. After the ligature is applied and the columns approximated, the patient should be kept constantly on his back, and the ligature not removed for eight or ten days, the free suppuration usually seen at this time facilitating the escape of the ligature when gentle traction is made on it.

Operation of Bowman, of Kentucky.—A puncture being made, a syringe with a very fine nozzle was introduced, and inflammation developed in the parts around the abdominal canal and ring, by the use of Lugol's solution or other articles. This treatment has been employed in six or eight cases, about one-half of which were successful. Jobert, of Paris, has recently reported the cure of a patient by this means.

Operation of John Watson, of New York.—The patient lying on his back, with the scrotum and left spermatic cord drawn slightly to the right side, and with the integuments over the left external abdominal ring slightly on the stretch, the point of a delicate bistoury was introduced directly down to the crest of the pubis, so as to touch without dividing the insertion of Poupart's ligament. Being then made to work freely in the loose tissue immediately in front of the ring, but without wounding the spermatic cord, the nozzle of a small syringe, charged with about a drachm of tincture of cantharides, was introduced, and the liquid injected to the bottom of the cut, the hand of an assistant pressing in the mean time over the inguinal canal so as to prevent the fluid from entering it or passing through the sac into the abdomen. A compress and spica bandage being then applied and an anodyne administered, the patient was kept on his back, and in a few minutes began to complain of pain, which was most severe along the spermatic cord, but by the next morning had nearly subsided. Eighteen days subsequently he was able to walk without his truss, no tendency to the protrusion being noticed; but, as he left the hospital, the future result was unknown.

Operation of W. H. Roberts, of Alabama.—Roberts employed a small silver syringe, whose canula was an inch long and terminated in a trocar-shaped steel point, near which were two small orifices for the exit of the fluid from the syringe, which would hold about fifty drops. After purging the patient freely, and administering an anodyne, the operation of invagination, etc. was performed, oil of cloves being, however, the liquid employed to develop inflammation. In six cases reported as thus treated, most of them were subsequently as bad as before.

Operation of J. C. Nott, of Mobile.—A man, aged fifty, labored under enlargement of the testicle and scrotal hernia. After the attending surgeon had removed the testicle, the operation proceeded as follows:—

Extending the incision a little above the external ring, the latter was fully cleared of connective tissue. The hernial sac having been already opened, a considerable portion was removed with the testicle to which it was adherent, and a leaden wire passed through the internal column of the ring, two or three lines from its margin and about four above the pubis. This, being continued down under the neck of the sac, between the latter and the pubis, was brought out through the external column of the ring, at a point opposite to the perforation in the other column, the object being to draw together the two columns of the ring, and at the same time compress the neck of the sac. A single knot being made in the wire, the latter was twisted by a pair of forceps as tightly as so weak a substance would permit, but the opening, being large enough to admit three fingers to pass into the abdomen, was only reduced by the operation to about half its breadth. The integuments were now united by suture, etc.

The wound suppurated very profusely, and was about six weeks in closing, owing to peculiar difficulties. Two months after the operation, a hard, insensible lump occupied the seat of the external ring, where the wire had been placed, and four months subsequently the patient, though engaged at hard labor, had had no return of his hernia.

Operation of Jameson, of Baltimore.—Having operated for crural hernia on a lady, who subsequently had a return of the protrusion, and begged to be relieved at all hazard, Jameson operated as follows: Having, by an incision similar to that required for strangulated femoral hernia, exposed the crural ring, a flap of integuments, two inches long and ten lines wide at its base, was dissected from the adjacent parts, reverted on itself, and introduced into the ring so as to plug it up, the wound being closed by several points of the interrupted suture. This operation cured the patient in this instance, but has not, so far as I know, ever been repeated.

Remarks.—The three cases operated on by Wood were, apparently, cured at the time of his report, though he desired a longer period to test the cure. The first case had then been operated on eighteen months, the second eight, and the third three months, but each continued to wear his truss. The discussion in the Medico-Chirurgical Society of Cincinnati, on Wood's paper, led to the expression of sentiments which all familiar with hernia will probably admit to be reasonable, viz.: that his operation, like that of Gerdy, only closes the external ring, and does not act on the internal ring or on the inguinal canal, and that though applicable to direct herniæ, it is not equally so in the oblique variety. The same objection holds good as to Wutzer's operation, a plan which mainly differed from that of Gerdy in the instruments employed, though often alluded to recently as a novel method.

SECTION I.

OBSERVATIONS ON THE RESULT OF THE OPERATIONS FOR THE RADICAL CURE OF INGUINAL HERNIÆ.

A strong desire to ameliorate the condition of those who labor under the evils of hernia, having led surgeons, as has just been shown, to investigate the possibility of effecting a radical cure of this complaint, their conclusions in respect to the results of one plan of treatment (trusses) have, in some instances, been so favorably received as to have induced a great number of patients to believe that radical cures of herniæ can be accomplished solely by the use of these bandages. The report of a committee of the Philadelphia Medical Society, appointed with a special view to the investigation of the truss of Chase,* has often been quoted as indorsing the opinion that his truss will accomplish a radical cure; but such has never seemed to me to be the true verdict of the committee. Though believing in the advantage of employing Chase's truss in preference to many others, their report says: "That the success, in cases of umbilical herniæ in young children, is almost general . . . that success in other varieties of herniæ, affecting subjects (children) of similar ages, is by no means rare under the operation of trusses with soft pads; that, in children over ten years of age, it (*a radical cure*) becomes rather uncommon; that in youths between the age of puberty and twenty years, it (the radical cure) becomes rare, and after the latter period *very rare*." This committee defined a radical cure as follows: "A cure is radical when the tendinous and fascial barriers to the egress of the bowels are brought or restored to their normal or original firmness and power of resistance," to which I would add, and capable of permitting the ordinary actions of life, during three years, without the reappearance of the hernia. Under this definition, there are few cases of adults over twenty years of age that are shown to have been cured in the many works which I have consulted, and I therefore respectfully reiterate the opinion that a radical cure of hernia (not congenital) in a patient over twenty years of age, has very rarely been accomplished by a truss. Temporary relief has enabled some patients to go without the truss for a few months, but in the majority of instances I think it will be found that the complaint has or will reappear in about three years. Nor is this opinion solely that founded on my individual observation of a large number of Chase's patients, as well as those treated by myself with his truss. T. Wood, of Cincinnati, who was a private pupil of Chase, and specially instructed in his opinions and mode of treatment, and who also saw numbers of patients treated by him, says, in an extended article on the radical cure of herniæ:* "I have seldom met with a patient who had not a hernia at the end of two years' treatment. I have much more rarely met with one that remained cured at the end of three years; and I have never known one to be radically cured of a hernia at the end of four years' treatment by any means whatever. The conviction is therefore indelibly stamped on my own mind that no truss will effect a radical cure of hernia, any more than indigo will cure epilepsy, or the thousand and one corn salves will radically cure those troublesome customers that torture your toes."

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* Report of Committee of Philadelphia Medical Society. Philad. 1837.

In thus expressly advancing the opinion that a hernia is not radically cured by a truss in the majority of instances after the age of eighteen years, or after the period when the patient's frame is well developed, I am fully aware that others entertain somewhat less decided sentiments on the subject, and the reader will therefore view the opinion as that based chiefly upon individual experience. It may be that I have been unfortunate in the selection of cases, or that I was wanting in surgical skill, but as others may be similarly situated in this respect, I humbly desire to prevent any young surgeon from accidentally misleading his patients into the belief that the use of a truss will cure them, lest the result cause them to charge him either with ignorance or willful deceit, and induce them to place him in the same class with the miserable characters who profess to cure all disorders.

Although decided in my own views on this subject, I wish it to be understood that my opinion and that of Wood also differ from that of the committee appointed by the American Medical Association in 1852, to report on the radical cure of herniæ. This committee—composed of Hayward, J. M. Warren, and Parkman, of Boston—"regard compression, when properly employed, as the most likely means of effecting a radical cure in the greatest number of instances," and some of the French surgeons coincide with them. Many, however, both of the French and English school, have dissented from this opinion; and the reader will, therefore, see that the question is by no means settled, and should so regulate his opinion as to protect himself from the suspicion of willfully misleading his patient, by candidly stating to him the uncertainty of the result. Let the adult fully understand that while he wears a truss that is accurately fitted, he is as secure as he can be against the dangers of strangulation; that his hernia will not be so liable to give him trouble as it was before the application of the truss, no matter what he may do; that while he wears it there is a *chance* of cure, but that, in all probability, he will find it essential to his safety to wear a truss for many years, if not for life.

The other measures which have been resorted to in the attempts to cure herniæ radically, date back to a very early period of the profession—Celsus, Aetius, Guy de Chauliac, and other surgeons having advised various means of accomplishing it. Few, however, seem to have presented unexceptionable facts, as each period appears to have been dissatisfied with the acts of its predecessors, and to have endeavored to remedy their operations, or suggest others. The application of a ligature around the neck of the sac was advised especially by Guy de Chauliac, A.D. 1360, who directed that the sac should first be laid bare, in order to strangulate it with greater certainty at its root. The use of a leaden ligature, and the approximation of the sides of the ring, as advised by Nott, of Mobile, present a modification of this operation, which may prove to have several advantages over the old-fashioned thread and the strangulation of the neck of the sac, and, as it does not constrict the cord, (being placed below it,) is worthy of further trial. Of the operation of Gerdy, I have only to say that my personal observation of many of his cases in the Parisian hospitals in the year 1839, did not induce any confidence in its ultimate success; while the plans of Velpeau, Belmas, and others have not been sustained by general professional experience. The modification of the plastic operations also, tried many years ago by Jameson, of Baltimore, has been well thought of; but, though this patient was cured, I am not aware that his operation has been repeated.

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* Western Lancet, vol. xii. p. 277, et seq.

Summary.—Upon the whole, I incline to the opinion that though any of these operations, when followed by the use of the truss for two years, may benefit the patient for the time, yet the result of the operations will ultimately be unsatisfactory in the majority of cases. As these operations have, however, succeeded, at least for some few months, other surgeons may deem it proper to repeat the trial. If called on to select any one method, I should prefer the plan of Wood, of Cincinnati, or the use of a leaden ligature below and around the ring and neck of the sac, in a manner somewhat similar to that reported by Nott, of Mobile; while, if a more simple operation was desirable, I should resort to the use of the injection as practiced by Watson, Roberts, etc. Many of those most experienced in the result of these operations are, it will be seen, like myself, far from being satisfied of their ability to effect a radical cure. Roberts expresses the opinion,* based on the record of his cases, that, so far as the danger of the operation is concerned, he has yet to learn that any existed, having seen the intestines come down the day after the operation and returned without bad consequences. He has also seen the oil of cloves thrown into the sac when the omentum was there, and retained without trouble. Yet, since the latter part of 1847, he has had so little confidence in the operation as to have given it up, preferring to rely upon the introduction of a small seton at the external ring. Wood also, it will be seen, was not sufficiently satisfied with his success, at the date of his report, to recommend his operation as a radical cure.

In a valuable and recent report on the statistics of herniæ, by Samuel B. Richardson, of Louisville, Ky.,† the following opinions are given from Kentucky surgeons who were applied to by the reporter.

Swain, of Ballardsville, "does not *know* that he ever effected a radical cure—*supposed* he had in one instance by a solid pad and truss."

Chew, of Midway, "has effected a radical cure in one case, in a boy aged 15, by the wooden pad truss."

Sutton, of Georgetown, "thinks he has treated in all not exceeding a dozen cases of hernia, mostly children, and successfully by retentive trusses alone."

J. B. Flint, of Louisville, "has performed none of the operations proposed for the *radical* cure of hernia—regards them as opposed to the canons of sound surgery, and not to be compared to a well-adjusted retentive truss."

John C. Richardson, of Lexington, "has cured radically several cases of hernia in young children, by simple compress and bandage."

Among the advocates of a cure by Wutzer's operation, is T. L. Ogier, of Charleston,‡ who reports twelve successful cases, and nineteen others, also successful, but not reported.

Nott, of Mobile, on the contrary, reports Velpeau and Nélaton as expressing the opinion "that Wutzer's operation or any other on similar principles is unreliable, the disease returning in the great majority of instances." This, as before stated, has been the result of personal observation since 1839, and I have seen no reason to change my former estimate of the treatment.

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* Southern Med. and Surg. Journ., vol. ix. p. 236

† Semi-Monthly Med. News, vol i. p. 161. Louisville, 1859.

‡ Charleston Journ., Jan. 1860.

CHAPTER V.

STRANGULATED INGUINAL HERNIÆ.

Oblique or Indirect Inguinal Herniæ, in the male, consists, as before stated, in a protrusion of some of the abdominal contents through parts which have been left in a weakened condition by the descent of the testicle from the loins to the scrotum. In the female, this form of hernia passes through the openings left for the passage of the round ligament of the uterus in its course to its insertion. When the protrusion occurs directly through the abdominal parietes behind the external abdominal ring, and without following the course of the inguinal canal, it constitutes the form of the complaint which has been designated as **Direct Hernia**. As **Oblique Herniæ** is the most common, a reference to the changes induced upon the parts by the descent of the testicle will facilitate the comprehension of the anatomical relations of such portions as are directly connected with the operation required for its relief when strangulated.

SECTION I.

SURGICAL RELATIONS OF INGUINAL HERNIÆ.

The anatomical details of the abdominal parieties belonging to special anatomy, and being generally among the elementary studies of every medical student, I shall not now enter upon a description of the muscles, fasciæ, etc. which compose the abdominal walls, but limit this account to a few of the points especially connected with the surgical relations of inguinal hernia.

The split or opening in the tendon of the external oblique muscle of the abdomen, or the **External abdominal ring**, is found near the point where the tendon or ligament of Poupart is attached to the spine and symphysis of the pubes. This opening or ring being somewhat triangular in its shape, has its base resting upon the pubis, while its summit is lost in the general fibres of the tendon of the external oblique. It is covered by the skin and fat as well as by the **fascia superficialis abdominis** of Camper, while the space or opening contained between its sides is filled with loose areolar tissue in the normal condition, though the existence of hernia may so thicken it as to justify the name of **intercolumnar fascia**. Through this ring the spermatic cord of the male and the round ligament of the uterus in the female are transmitted, either to the scrotum or pubis, both of them inclining very much to the outer side—**outer column**—of the ring. In the integuments over this ring we find a small artery and vein—**arteria et vena ad cutem abdominis** of Haller. Behind the ring is the common insertion of the rectus abdominis and pyramidalis muscles, which tends very much to strengthen the part and prevent, except in ventro-inguinal hernia, the descent of the bowels at this spot; but this common tendon does not constitute one of the cover-

PLATE XLIII.

SURGICAL RELATIONS OF THE PARTS CONCERNED IN HERNIÆ.

Fig. 1. A view of the relation of the Internal Oblique and Transversalis Muscles to Inguinal Herniæ, showing the mode of formation of the Cremaster Muscle. 1. The tendon of external oblique, a portion of the muscle and its tendon having been excised in order to show the parts beneath. 2. The fibres of the internal oblique. 3. A section of the tendon of the external oblique everted upon the thigh, and showing the origin of the internal oblique and transversalis muscles from Poupart's ligament. 4. The common tendon of the last two muscles. 5. The cremaster muscle as seen upon the cord, but not extended upon the testicle, as is usually the case. *After Bernard and Huette.*

Fig. 2. A view of the relation of the Transversalis Muscle and Fascia. 1. Transversalis muscle, as shown by the removal of the parts above it. 2. Circumflex ilii artery in its course to anastomose with the ilio-lumbar. This artery lies between the transversalis and internal oblique muscles. 3. The femoral artery exposed by opening its sheath. 4. The femoral vein. *After Bernard and Huette.*

Fig. 3. Formation of an Inguinal Hernia at the internal ring, and the relative position of its coverings. 1. Tendon of the external oblique everted. 2. Section of the fascia transversalis. 3. Intestines seen through the peritoneum. 4. The cord. 5. Mouth of the hernial sac. *After Bernard and Huette.*

Fig. 4. Relative position of the coverings of an old Scrotal Hernia, as shown by laying open the part. 1. Penis hooked back. 2, 2. Skin pinned back. 3, 3. Fascia superficialis. 4. Dartos muscle. 5. Internal layer of dartos. 6. Tendon of the external oblique, with the external abdominal ring. 7. The spermatic cord. 8. Tunica vaginalis communis, or fascia propria. *After Bernard and Huette.*

Fig. 5. Relative position of constituents of the Cord. 1. Tendon of the external oblique. 2. The same slit open. 3. Fibres of the internal oblique and transversalis, or the cremaster muscle. 4. Tunica vaginalis communis. 5. Probe passed beneath the vessels of the cord. 6. Vas deferens. *After Bernard and Huette.*

Fig. 6. Relations of the coverings of the Testicle. 1. Tunica albuginea. 2. Tunica vaginalis testis. 3. Cremaster muscle and tunica vaginalis communis of the cord. *After Bernard and Huette.*

Fig. 7. Mode in which a Hernial Sac is formed. 1, 1. Point of protrusion. 2, 2. Intestine about to escape. 3, 3. The peritoneum as protruded in front of the intestines. *After Bernard and Huette.*

Plate 43.

Fig. 1.

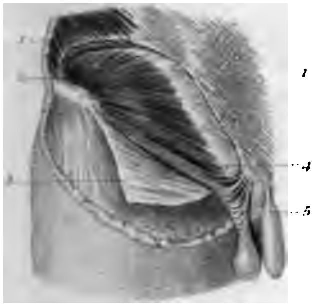


Fig. 3.

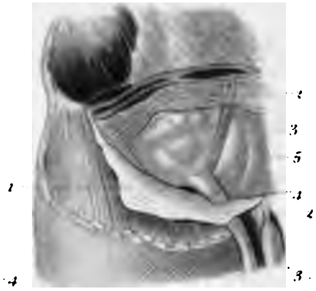


Fig. 2.

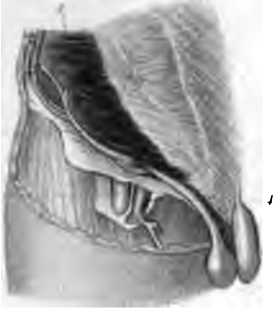


Fig. 4.

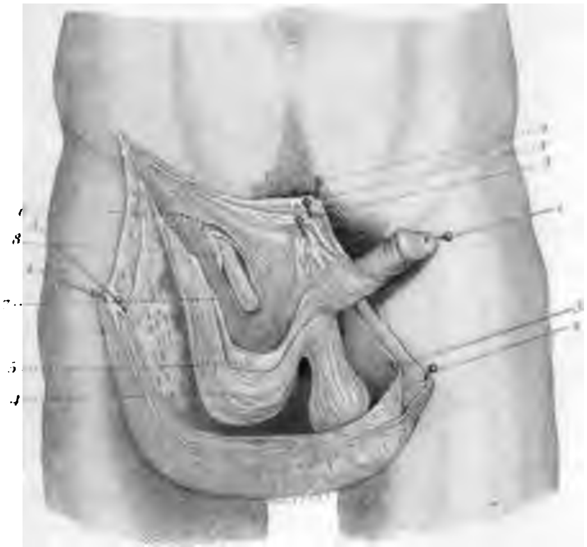


Fig. 5.

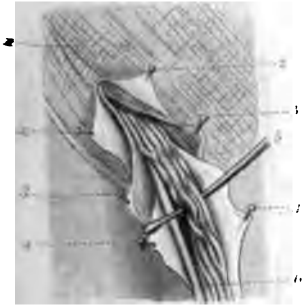


Fig. 7.

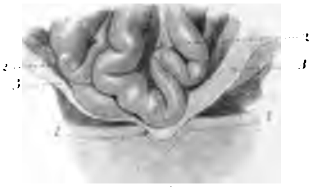
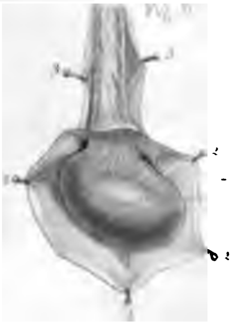


Fig. 6.



ings of herniæ, as is stated by some anatomists. Extending obliquely upward and outward from this ring—for the extent of an inch and a half in the normal condition—is the space or flattened passage designated as the **Inguinal canal**, though, except when distended by a hernia, it cannot properly be spoken of as a canal. Behind, it is bounded by the rectus abdominis muscle and fascia transversalis, to which it chiefly owes its strength; below, by the crural arch; while its anterior and inferior boundaries are chiefly due to the imperfect fibres of the internal oblique and transversalis muscles, to the tendon of the external oblique, and to the fascia superficialis and skin. Throughout its length, we find the spermatic cord of the male and the round ligament of the female, and when an oblique hernia descends through it, these structures will generally be found behind, below, and within the hernia. The upper, posterior, or external orifice of this canal is designated as the **Internal abdominal ring**, or opening in the fascia transversalis, though such an opening never exists in the normal condition of the parts, as a process of the peritoneum as well as of the fascia transversalis is extended upon the cord and into the canal in its healthy condition; the presence of the internal ring is therefore always due either to dissection or to the pressure of a hernia by which its edges become defined. On the inner side of the internal ring, when it exists, or on the inner side of the cord or round ligament, is found the **Epigastric Artery**, which, running vertically upward, or nearly parallel with the fibres of the rectus muscle, has the peritoneum behind it, and the fascia transversalis in front of it. Through these structures the fœtal testicle and oblique inguinal hernia descend in their course from the abdomen to the skin, and in the course of this canal must the taxis be practiced, when the effort is made to restore a reducible hernia.

The **Spermatic Cord** is composed of the vas deferens or duct of the testicles—the spermatic artery—veins and nerves, and of the tissues that are made to cover them by the normal descent of the testicle from the loins to the scrotum. As the oblique hernia follows the same course as the testicle, the study of the descent of the latter is essential to the comprehension of the coverings and relations of this variety of hernia.

When the testicle of the fœtus leaves the loins in its descent to the scrotum, it pushes before it that portion of the peritoneal sac which lies in front of the intestine; then presses in front of it, and extends a portion of the fascia transversalis; next a few fibres of the transversalis muscle; then a few of those of the internal oblique muscle, the two together constituting the cremaster muscle. Passing then through the external abdominal ring, it extends the portion of the cellular tissue which is between the sides of the ring and the fascia superficialis, and, lastly, drops into the pouch of the skin known as the scrotum. When in the scrotum, this gland is, therefore, covered by the **skin, fascia superficialis, cremaster muscle, condensed areolar tissue,** (tunica vaginalis communis,) and by the **peritoneum,** (tunica vaginalis testis,) the cord having the epigastric artery between the linea alba and the line of its descent in the thus formed inguinal canal.

Shortly after taking its position in the scrotum, the tube-like process of the peritoneum, which then extended from the scrotum to the abdomen, is obliterated, though sometimes it remains open, as in **congenital herniæ**, or congenital hydrocele, or is only closed at points, as in encysted hydrocele or hydrocele of the cord. The process of the fascia transversalis (extra-peritoneal areolar tissue) which had been protruded in a pouch like the peritoneum, but contracted into a tube-like prolongation on the cord, is then gradually changed, and loses its dense characters, except on the surface next to the peritoneum, where it presents a funnel-shaped depression at and around the cord, while the remaining layers contract upon the cord and are diminished in character and distinctness.

A portion of intestine or omentum (hernia) pressing against the peritoneum at the same point of the abdominal parietes, does the same thing as the testicle did, that is, it pushes forward a portion of the peritoneum, unless the sac formed by the descent of the testicle has not been cut off from its connections with the general peritoneal cavity, when it passes directly into the same sac as the testicle—congenital hernia.

On reaching the fascia transversalis, it also slightly distends it into a sort of pouch; but as the pressure is continued, the edges of this pouch at the point of pressure become thickened, especially in old hernia, and take on a defined shape, thus constituting **the internal ring**, while the centre is either absorbed or converted into a reticulated structure—fascia propria—and then the tumor, passing on, takes a position in front of the cord, but also a little toward the median line of the body. Being here beneath the fibres of the transversalis and internal oblique muscles that thus constitute the cremaster muscle, the hernia escapes through the external ring, pushes before it the areolar tissue which usually fills up this ring—intercolumnar fascia—and, pressing it against the superficial fascia, the two become blended in one, and there only remains the additional covering of the skin. In operating upon an inguinal hernia, there are, therefore, usually found the **skin**, the **superficial fascia, cremaster muscle, fascia propria** and **sac**, all of which must be divided before the contents of the tumor can be made apparent.

The only blood-vessels about this class of tumors are the small artery and vein (ad cutem abdominis) before spoken of as being found directly beneath the superficial fascia, and the epigastric artery and vein, which is directly beneath the transversalis fascia. The arteria ad cutem abdominis is therefore between the fascia superficialis and the external oblique tendon, while the epigastric artery is between the fascia transversalis and the peritoneum. In indirect or oblique inguinal hernia, the epigastric artery is toward the inner side of the contents of the tumor—that is, toward the linea alba—and runs parallel with the external edge of the rectus abdominis muscle, while in direct or ventro-inguinal hernia, or that in which the protruded part does not follow the entire course of the spermatic cord, it may be upon its outer side, Plate XLII. Fig. 3. But as the pressure of the hernia upon the peritoneum and fascia transversalis elongates the first, and causes a thickened margin to the second, this artery is removed a line or two from the edge or margin of the opening in this fascia, designated as the internal abdominal ring. In the normal condition of the parts, the distance between the internal and external abdominal rings is about an inch and a half, the internal ring being about this distance exterior to the external ring, or about as much nearer to the anterior inferior spinous process of the ilium. But in hernia, the traction caused by the protruded parts, especially in old hernia, *approximates these two rings, so that one is often very nearly in contact, and also behind the other*, and the epigastric artery is brought therefore more toward the external ring and the linea alba; but unless an extraordinary arrangement exists, it will yet run parallel to the anterior edge of the rectus muscle, and be on the median or internal side of the protrusion.

SECTION II.

TREATMENT OF STRANGULATED INGUINAL HERNIÆ.

The treatment demanded by inguinal herniæ consists in that required for the restoration of reducible hernia, and that requiring the division of the parts by the knife for the relief of strangulation.

§ 1.—Taxis in Reducible or Strangulated Inguinal Herniae.

Taxis, as employed for the purpose of replacing an inguinal hernia within the cavity of the abdomen, consists in manipulating the tumor so as to press the portion which was last protruded, directly within the ring or opening through which it has passed, the remaining part usually following readily the course of the first, if a judicious continuance of the pressure is persevered in.

In making the taxis in cases of strangulated inguinal hernia, it is essential to success that the parts through which the hernia has protruded should be in a state of perfect relaxation, and that the patient should offer no resistance to the manipulation of the surgeon; but as a strangulated hernia soon becomes painful, some little opposition may always be anticipated, unless means are taken to prevent it. The use of anæsthetics in these cases is, therefore, especially demanded, in order to obviate this resistance as well as to relax the muscles generally. As the position of the patient also materially facilitates the operation of taxis, he should, before being etherized, or when the latter agency is not employed, be placed upon the back with the knees drawn up and the shoulders well raised and supported by pillows, in order to relax the abdominal parietes. The surgeon, being then placed upon the affected side, should seize the tumor with one hand, and draw it gently downward, so as slightly to elongate it; then, placing his thumb and first two fingers at the upper part of the tumor, so as to compress or squeeze it gently, let him force back a portion of the intestinal contents, if possible, so as to reduce the bulk of the tumor, and, pushing the portion last protruded upward and backward, compress the lower part of the swelling with the fingers and thumb of the other hand, in the same manner that he would squeeze a caoutchouc bottle to empty it of air. If, after a short time, the tumor diminishes in size, its base may be approximated to the summit, and the effort made with the fingers of the hand near the ring to push into the abdomen some small portion of it, or this part may be slightly compressed by these fingers, while the others endeavor to replace another portion. Should the effort, however, not succeed, the fingers and thumbs of both hands should be made to force upward and backward all portions of the mass, kneading it so as to empty it of its contents; or a part of it may, if possible, be inverted by pressing the forefinger toward the ring, and then retaining it there a few seconds, Plate XXXIX. Fig. 6. If, after moderate manipulation in this manner, no diminution of the swelling is perceptible, the taxis should cease, the patient be allowed to rest, or his position be changed to such a direction as might induce the intestines within the abdomen to gravitate in a different direction from the hernia, and thus facilitate its return. If, however, a very small portion of the tumor can be replaced, the rest will usually follow; and when the protruding portion is intestine, a distinct gurgling sound will be perceived as the last part returns to the belly, in consequence of the liquid or gas which had been confined in the constricted portion again passing into the main channel.

New Method of making Taxis.—After vainly employing the usual means of reduction, as just detailed, Wise, of India, succeeded in restoring a strangulated hernia by the following plan, it having been suggested by a Mussulman gentleman, who had seen it successfully applied: "Place the patient on a table, and having folded a long sheet several times on itself, carry it around the lower part of his pelvis, twisting it on itself in front, and again at the sides, so as to enable the assistants, who stand on each side, to hold the extremities of the sheet, and pull them gently upward, or toward the patient's head, while a third assistant holds the feet, and the surgeon makes the taxis. As the gut immediately above the strangulated portion is often superficial, and distended with flatus and liquid, it will be drawn upward from the hernial sac, while the return of the protruded portion is favored by the taxis practiced by the surgeon."

If, after one or two trials of either or both of these means of making the taxis, no change is effected, then it may become a question whether it is better to resort to herniotomy or to repeat the taxis.

In small herniæ, where the constriction is tight, the part painful, and the patient vigorous, the repeated attempts at taxis, or a resort to anything like forcible pressure, is always dangerous, and tends to the development of inflammation in the part. When, therefore, in such cases, no progress is made, notwithstanding a judicious employment of the anæsthetics and the adjuvants before alluded to, a repetition of the taxis can only tend to increase the patient's danger. But in large and old herniæ, unaccompanied by much pain, or where the hernial contents have occasionally been down before, but were reduced with some trouble, the repetition of the trial may succeed, especially if cold applications are made, as before directed, to the tumor in the interval of the attempts. In recent and small herniæ, great judgment in the use of pressure will be required, and, as a general rule, it will prove best not to employ the taxis too long, say more than twice, provided the manipulation is correctly practiced, that is, in the line of the axis of the tumor, or upward toward the cavity of the abdomen and in the line of the inguinal canal. In other cases, the demand for a prompt resort to the operation is not so urgent, as it has more than once happened that in these herniæ, after everything has been tried and a resort to the knife been decided on, a slight and apparently hopeless effort has suddenly caused the tumor to disappear within the abdomen. With young surgeons, there is apt to be too much delay in resorting to the knife, and the force employed in the taxis is often too great. It should always be remembered that delicacy of manipulation will generally succeed better than force, and that the ultimate success of the operations for the relief of the strangulation has been most marked in those cases where it was not delayed until positive and high inflammatory action was established. Desault assumed it as a maxim that "success might always be anticipated in a hernia which had not been touched before operating," and was often successful where strangulation had existed five days, but almost constantly failed when strong efforts had been previously made in the taxis. The resort to cold combined with moderate pressure, such as that produced by placing a pound weight on the tumor, when continued for a half hour, has frequently succeeded even when judicious taxis had failed; and it may be readily accomplished by the application upon the swelling of any substance of this weight. But the dangers of delay should be borne in mind, even when these means are employed, though they are less likely to excite inflammation than the repeated pressure of the fingers in the taxis, it being generally admitted "that a surgeon may have occasion to regret performing the operation *too late*, but never *too early*."

In making taxis for the relief of strangulated hernia, whether before or after the incision of the tissues, it is important that the symptoms of strangulation should disappear when the reduction is accomplished. Should they not do so, and yet the restoration of the hernia within the abdomen be certain, it may become necessary to incise the canal and seek for the constricted tumor in the abdomen, as the condition of the parts concerned in the reduction "*en bloc*" or "*en masse*," as the French describe it, requires prompt relief.

Reduction of a Strangulated Hernia in Mass.—As death has sometimes ensued upon the employment of the taxis, in certain cases of strangulated hernia, in which, though the contents of the tumor were evidently returned into the abdomen, the symptoms of strangulation yet existed until the termination of life, the attention of surgeons was given at an early period to the investigation of the cause, and from the *post-mortem* appearances of these cases, it was discovered that the symptoms were the result of the return of the whole tumor into the abdomen, while the stricture existed in the neck of the sac. This condition of things was so rarely met with that, when it was first reported by Ledran, Scarpa, and Louis, many of the surgeons of their time denied the possibility of the occurrence. Closer investigation has, however, shown that such an accident is not so exceedingly rare as was at first supposed—Dupuytren, Breschet, and Jobert, among the French surgeons; Sir Charles Bell, Cooper, Lawrence, and Luke, among the English; and Joseph Parrish, Cheeseman, and Blackman, of the United States, having, at different periods, noted similar cases, and called professional attention to them.

Treatment.—In order to relieve a patient under these distressing circumstances, whether resulting from the taxis or from an operation in which the sac has not been opened, the first efforts should be directed to obtaining, if possible, the reproduction of the hernial tumor. Sometimes this is said to have been easily done; but in most of the cases reported by those whose attention has been directed to this complication of hernia, it has proved difficult, or even impossible; and nothing has therefore remained but to open the canal freely, draw out the sac, and divide the stricture which existed at its neck, an operation which has rarely terminated successfully. In order to guard against the reduction "*en masse*," during the operation of herniotomy, the finger should be passed around the inner side of the neck of the sac before restoring the hernia.

§ 2.—Operation of Herniotomy in Strangulated Inguinal Herniae.

The operation of **Herniotomy**, or the division of a stricture in order to relieve the strangulation of a hernia, consists in dissecting the different coverings of the tumor, and then nicking the constricting part, so as to enable it to yield to the pressure subsequently made on the contents of the tumor, avoiding a large incision of the ring, lest the patient be afterward unnecessarily exposed to a further escape of the viscera.

Preliminary Measures.—Before commencing the operation, the surgeon should properly prepare such instruments as may be required, as well as the dressing. In most cases, he will find it useful to select one good scalpel, one sharp-pointed bistoury, one director, one pair of dissecting forceps, one Cooper's bistoury, Plate XXXV, Fig. 16, or one probe-pointed bistoury wrapped to within an eighth of an inch of its point, and not sharp; a tenaculum, ligatures, needles, and sponges, together with adhesive strips, a piece of linen spread with cerate, a compress, and a bandage sufficiently wide to form a spica of the groin. Then the hair should be shaved from around the tumor, so as to prevent its interfering with the subsequent dressings, the bladder emptied of its contents, a narrow table, well covered, so arranged that the patient's hips can be brought near to its end, and his feet be supported on chairs, room being left for the operator to stand between the knees. Should the operation be demanded after sunset, as is often the case, several sperm candles should be added to the other general arrangements. Three assistants will prove useful: one to aid the operator in his incisions, one to sponge blood from the wound, and one to attend to the etherization or the wants of the patient.

Ordinary Operation for Strangulated Inguinal Herniæ.—In commencing the operation of herniotomy for strangulated inguinal herniæ, the selection of a mode of incising the skin must depend upon the abilities of the operator. If he is dextrous, its division may be effected by holding the scalpel in the third position, or like a pen, Plate II. Fig. 5, and cutting in the axis of the tumor from the upper to the lower portion. But if this is not the case, and especially if the patient is fat and the skin thick, it will be better for the surgeon to pick up a fold of it transversely to the axis of the tumor, Plate II. Fig. 4, between the thumb and fingers of his left hand, while the assistant raises the opposite end of the fold in a similar manner, Plate XLIV. Fig. 4, and thus keep the integuments elevated from the subjacent parts. Then, puncturing this fold in its middle, with a bistoury incise it by cutting from within outward, or the reverse, so as to expose the fascia superficialis to the full length of the proposed incision; or if the cut thus made is not long enough, then extend it at its angles by raising the sides of the incision in the same manner. After exposing the fascia, the distinctive characters of each of the subjacent layers may or may not be readily made out, according to the changes that have been created in the part by the complaint. To guard against error, the subsequent layers should, therefore, be picked up with the forceps, so as to form a little fold at the most prominent point of the tumor, Plate XLIV. Fig. 5, and this being nicked by pressing the scalpel against it, while the surface of the blade lies flat upon the tumor, an opening may be made, and a director passed underneath the tissue, so as to enable the operator safely to slit the layer up and down to the extent that may be desired. Next, picking up another layer in the same manner, treat it likewise, Plate XLIV. Fig. 6, and proceed to divide the coverings until the contents of the tumor can be distinctly felt, or perhaps indistinctly seen beneath the serous layer or sac, the latter being more or less thickened, according to circumstances, although it never presents the shining appearance of peritoneum on its outside, owing to the changes produced by the disorder. In the division of each layer, attention should always be given to its appearance, and especially to the presence of muscular fibres, as these will generally show the position of the cremasteric lamina, and serve as a most important point of reference. On reaching the last layer, or that which is believed to be the sac, pick it up with the forceps and rub it between the thumb and fingers of the left hand, so as to be sure that there is no other portion of structure included; nick it, introduce the director, and slit it up, Plate XLIV. Fig. 6, when the bowel or omentum will be fully displayed, the first presenting a sort of doubling or knuckle, and being more or less of a reddish-brown or gray tint, and the latter looking not unlike a mass of fat and connective tissue, or like the structure usually seen in front of the intestines when *in situ*, unless it has been very much engorged by the constriction.

Having thus reached the contents of the tumor, it only remains to divide the stricture, the position of which, though varying somewhat, may generally be discovered by passing the forefinger into the wound in the line of the spermatic cord of the male, or of the round ligament of the female.

If the stricture is seated, as is often the case, at the neck of the sac, it may be felt at the external ring, or below it, or at the internal ring, the latter being, especially in old herniæ, directly behind the external ring. Then, as it is sometimes difficult to tell whether the hernia has been direct or oblique, and, of course, whether the epigastric artery is on the outer or inner side of the neck of the sac, pass the forefinger as far up as possible, and endeavor to get the *finger nail* between the constriction and the bowel, depressing the latter by bearing on it with the back of the finger, while an assistant also keeps it as much as possible out of the way, or the director may be substituted for the finger, if the stricture is very tight. With the probe-pointed bistoury, wrapped to within a few lines of its point, or with Cooper's bistoury, Plate XXXV. Fig. 16, and with the cutting edge of it rather dull than sharp, the operator may now free the stricture by passing the blade flatwise along the palmar surface of the forefinger, or along the groove of the director, Plate XLIV. Fig. 9, and carrying the point beneath the stricture, when, having accomplished this, it only remains to turn its edge *directly upward*, so that it shall be parallel with the external margin of the rectus abdominis muscle. Then, depressing the handle, cause the edge of the blade to press a little against the sharp constricting border of the ring, so as to nick it, Plate XLIV. Fig. 7, or give the blade a gentle rocking motion, so as to repeat the cut, and when there is the least sensation of rending, turn the knife again flatwise, withdraw it, and strive to dilate the stricture by the pressure of the finger, or endeavor to replace the intestine or omentum, if its condition is suitable, by making the taxis as before directed. If the nick of the stricture has not been sufficient, a similar manipulation of the bistoury may then be repeated until the opening is sufficiently enlarged to allow the hernia to pass, though usually the ring will yield to pressure as soon as its thickened edge is notched.

After freeing the stricture, the condition of the contents of the tumor should be attentively examined, before attempting either its restoration or the dressing of the wound, and it is especially important that the operator should see that the stricture is not continued by the neck of the sac, or by a band of omentum, etc., as is sometimes the case, and an instance of which is related by Parrish. If there are one or more small and pea-like spots, which present the appearance of positive sphacelation, these points should be picked up in the forceps, and tied by encircling them with a fine ligature, which, after being cut off close to the knot, should be left upon the part, and returned into the abdomen with the intestine, when, by ulcerating through the coats of the latter, they will be discharged per anum, while the opening that would otherwise have ensued will be filled with lymph, as the result of the inflammation thus excited. But if the sphacelus is more extended, say half an inch, then it may be advisable to attach the coats of the bowel to the side of the wound by a suture, lest the intestine escape into the cavity of the abdomen, and the separation of the slough give rise to peritonitis. If fastened in the wound, the sloughing of the bowel can only produce an artificial anus, the healing of which will often be accomplished by nature, or may be effected by some of the means hereafter directed. Many experienced surgeons have, however, regarded the use of this suture with distrust, Desault and others having shown that the inflammation which preceded the gangrene caused sufficient effusion of lymph to retain the bowel at the neck of the sac: the resort to the stitch is, therefore, a rare event.

PLATE XLIV.

A VIEW OF THE OPERATIONS PERFORMED FOR INGUINAL HERNIÆ.

Fig. 1. The first step in Gerdy's operation for the radical cure of Reducible Inguinal Herniæ. 1. The needle, with an eye near the point, in the act of transfixing the integuments as inverted by the forefinger. 2. The first loop of the ligature. *After Bernard and Huette.*

Fig. 2. The second step in this same operation. 1. The needle about to form the second stitch. 2. The first loop as placed. 3. The second loop as drawn from the needle. *After Bernard and Huette.*

Fig. 3. The last step in this operation. Quills having been placed in the proper position, the ligatures have been tied upon them so as to retain the pouch of skin at the ring. 1, 2. The quilled suture.
After Bernard and Huette.

Fig. 4. The first incision of Inguinal Herniæ. A fold of the skin, having been raised transversely over the tumor, is about to be divided by the scalpel from without inward. It may be incised from within outward with safety, if the integuments are very thick, or there is a deposit of fat in the connective tissue.
After Bernard and Huette.

Fig. 5. Mode of dividing layers. A director having been introduced at the opening made by nicking the tissue, the scalpel or bistoury is passed along it so as to slit up each layer to a sufficient extent. *After Bernard and Huette.*

Fig. 6. Opening the Hernial Sac. 1. Forceps picking up a fold of the sac, and drawing it from the tumor. 2. The scalpel placed flatwise, and about to nick the portion thus raised. *After Bernard and Huette.*

Fig. 7. One mode of dividing the stricture. The forefinger nail being passed beneath the stricture, the probe-pointed bistoury, wrapped to near its point, is passed flatwise upon the finger as a director, and, its edge being turned up, the nick is made by bringing the handle (2) toward the hand (1) so as to give it a gentle rocking motion. *After Bernard and Huette.*

Fig. 8. Relations of the Intestine and Omentum in an Entero-epiplocele. 1. Intestine. 2. Omentum. 3. Director in the act of depressing the tumor so as to pass between the contents and the stricture. *After Bernard and Huette.*

Fig. 9. Mode of dividing the stricture upon a broad director, when the constriction is too tight to permit the passage of the finger beneath it. 1. The director. 2. The bistoury. *After Bernard and Huette.*

Plate 44

Fig. 2.

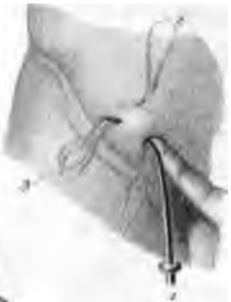


Fig. 1

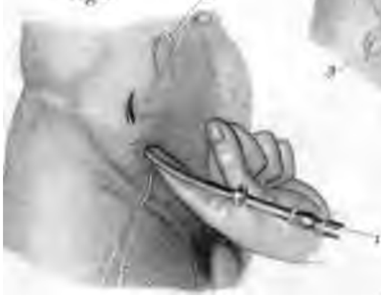


Fig. 3

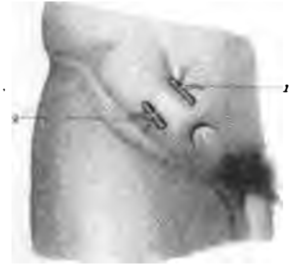


Fig. 4.

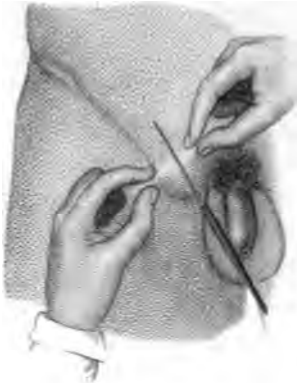


Fig. 6.

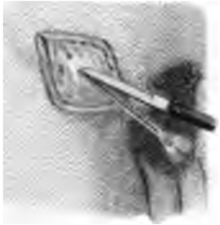


Fig. 5

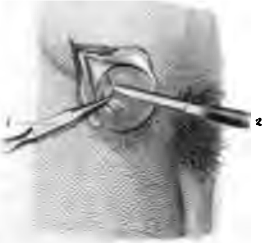


Fig. 8

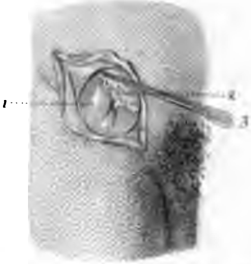


Fig. 7.

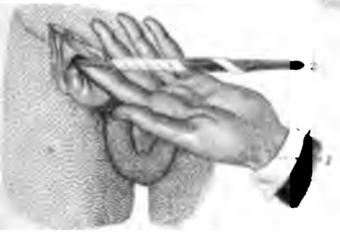
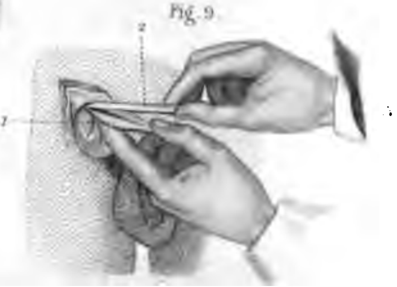


Fig. 9.



Should the contents of the tumor be omentum instead of intestine, and the strangulated portion of the former have become sphacelated, then the mortified part should be ligated, and the portion beyond the ligature cut off, the remainder being left as a plug in the opening, after which the dressing may be made as before directed.

Dressing.—If the operation has been promptly done, and the intestine is simply congested, the middle and upper angle of the integuments should be united by a point or two of the interrupted suture, leaving the sac in its place, a morsel of lint being introduced into the lower angle of the wound to prevent the skin healing, and also to preserve a vent for the subsequent suppuration. The adhesive strips, cerate, compress, and spica bandage being now applied, the patient should be carefully placed in bed, the thigh being flexed on the pelvis by folding a pillow and placing it beneath the ham.

After-Treatment.—When the parts have been returned into the abdomen, and freed from the constriction, it generally happens that the circulation is restored, and the structure resumes its original condition. But, in some instances, inflammation is developed, and general peritonitis follows the operation. Under these circumstances, an active and appropriate medical treatment will be essential to the preservation of the patient. When this is not the case, and there is no reason to apprehend perforation of the bowel, it will merely be necessary to administer a laxative enema, or some mild purgative, as a cathartic pill or rhubarb and magnesia, on the second day, the patient being compelled to keep in bed, and use a bed-pan or some other convenience when the purge operates, the diet during the first week being strictly restricted to light and farinaceous articles. When three or four days have elapsed after the operation, the condition of the wound may be inspected, and its subsequent treatment regulated by the general principles applicable to the cure of wounds; but when suppuration is established, the diet should be increased to such meats as are easy of digestion, the patient being confined to the supine posture until the part has healed sufficiently to bear the pressure of a light truss over the compress and bandage.

Complications sometimes met with in Herniotomy.—In the account just furnished of the operation required for the relief of strangulated inguinal herniæ, the effort has been made to limit the description to such details as are most frequently demanded. Several complications have, therefore, been intentionally omitted, lest reference to them should tend to embarrass the mind of the young surgeon, and appear to render the operation a very difficult one. A few of them may, however, now be briefly mentioned, as illustrative of the difficulty occasionally met with. Among the most common of these are the modifications of structue due to the changes that take place in the sac: thus, the sac may be concealed by coagulated blood, especially when the taxis has been employed violently for a long period; or the distinction between the sac and the intestine may be rendered difficult by their close adhesion, or by the presence of gangrene; or the areolar tissue outside of the sac may be heavily charged with fat, so as to add very materially to the thickness of the covering of the hernia. In one case, I estimated the thickness of the tissues through which I cut at half an inch, before I found the sac. At other times the testicle has been found involved in the tumor, or hydatids have been found in the sac, or the omentum has been forced out and strangulated by a cancerous tumor of the mesentery. Sometimes there have been two sacs; sometimes a very large amount of serum, and a very small portion of intestine, etc. etc. In fact, every possible variety or departure from the normal relations of the parts, or those usually given by anatomists, in their account of the position and appearance of this region in the healthy condition, will be met with in operating. It should, therefore, be remembered that all herniæ are liable to peculiarities, arising either from the duration of the complaint, the size of the tumor, the peculiar habit of the patient, or the means employed in the treatment—as violent taxis—or from the existence of other diseases—as hydrocele—or from the hernia being congenital, or from adhesions, or from the formation of bands at the mouth of the sac; but an examination of any of the valuable monographs that have been presented on this complaint will soon enable any medical man, who contemplates the possibility of performing this operation, to obtain a knowledge of these peculiarities. I must now pass them by. Little has also been said of the appearances of the parts under different degrees of strangulation, as these, together with many similar points, would have extended this account beyond its proper limits. Let it therefore suffice to say that, in every case where the experience of the operator has not been sufficient to qualify him for contending with such difficulties, he should, if possible, obtain the advantages of a consultation with some older practitioner. To be able to anticipate every peculiarity that may be met with in these cases, requires a combination of fortunate circumstances that none but those who have been widely engaged in surgery, or enjoyed the observation afforded by following the cases in large hospitals, or in the practice of old surgeons, can obtain. But, as a general rule, the well-educated practitioner will not err in the treatment of strangulated herniæ, if he opens the various layers cautiously, divides the stricture only so far as will relieve the obstruction to the circulation of the part, and does not replace the contents of a hernia in the abdomen before he is certain that its circulation is being restored, as may be told by its brighter or more natural color, a livid or ash color usually indicating a tendency to sphacelus. The division of the stricture, without opening the sac, has been sanctioned by Key, Liston, Gay, Teale, Luke, and many of the English school, who have reported very favorably of it: thus, Teale reports 32 cases operated on without dividing the sac, of which 27 recovered; and Gay reports* 125 operations in which the sac was not opened, and of these 73 recovered; while in 73 in whom it was opened, 13 died. The dangers likely to result from reduction in mass should, however, be remembered as militating against the advantages of this mode of operating, and the propriety of it, as an operation to be adopted by an inexperienced surgeon, is deemed by many others a matter of doubt. Thus, Chelius† says "that the mode of operating in which the hernial sac is not at all opened, is in general to be rejected, or specially confined to cases in which it is certain the strangulation is seated in the abdominal ring, as in a recently produced or very large rupture." Sir Astley Cooper, though advising this practice in large ruptures, after dividing the stricture at the neck of the sac, does not recommend it as a general rule. Lawrence prefers opening the sac, and South‡ does not think any great advantage gained by not opening the sac, as he coincides with Lawrence in the opinion that the peritonitis originates in the congestion near the seat of stricture, and that its dangers are not enhanced by the incision made into the sac in the restoration of hernia. The greatest objection to it is the risk that is always run of reducing the hernia "in mass," when, if strangulated by the neck of the sac, death will probably ensue. The subcutaneous division of the stricture, as advised by Guerin, is, in my opinion, a dangerous and uncertain operation, as stated by South, and only to be thought of in ruptures with recent strangulation from the ring. In strangulation by the sac, it is not applicable.

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* Brit. and For. Med.-Chirurg. Rev., No. IV. p 167.

† Chelius's Surgery, by South and Norris, vol. ii. p. 303.

‡ Ibid., p. 307.

§ 3.—Statistics.

In order to present some idea of the usual results of this operation, the following cases have been selected from various sources, and arranged so as to readily indicate the mortality:—

Statistics of Herniotomy in Strangulated Inguinal Herniæ.

			Cured.	Died.	Artif. Anus.
South[*]	reports	8 cases.	6	2	0
Astley Cooper[†]	"	11 "	8	2	1
Geoghegan[‡]	"	3 "	2	1	0
Lawrence[§]	"	9 "	5	4	0
Brand[‖]	"	2 "	1	1	0
Percival Pott[¶]	"	1 "	1	0	0
Scarpa[**]	"	7 "	6	1	0
Richter[††]	"	1 "	1	0	0
		42	30	11	1

From this it appears that, out of forty-two cases of strangulated inguinal hernia which were operated on, more than two-thirds recovered.

CHAPTER VI.

FEMORAL OR CRURAL HERNIÆ.

Femoral or Crural Hernia is that form of rupture in which the protrusion occurs at the anterior inferior portion of the abdominal parietes, or at those points where the external iliac vessels pass from the cavity of the pelvis under Poupart's ligament. On reaching this point, a hernia will generally follow the course of the sheath of the femoral vessels and then pass out at the opening—**saphenous opening**—of a superficial vein—**vena saphena**—till, reaching the exterior surface of the aponeurotic expansion which covers the muscles of the thigh—**fascia lata femoris**—it takes a position a little below the line of the groin. The contents of this tumor, like that described in the preceding chapter, may be either intestine or omentum, the latter being the least common, though, from the position of the cæcum, a portion of the large intestine has occasionally been found in the sac on the right side, and in one case, reported by Van Buren, of New York, even on the left side, instead of the smaller bowels, as was the case in inguinal hernia. Femoral herniæ are most common in females—are usually smaller than inguinal tumors—are always found beneath, and not above, the line of Poupart's ligament—spread sideways as they increase, and have their greatest diameter to correspond with the oblique line of the groin.

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[*] Chelius, by South, vol. ii. p. 312.
[†] Treatment and Anat. of Inguinal Hernia.
[‡] Commentary on Treatment of Ruptures, by Ed. Geoghegan.
[§] Treatise on Ruptures.
[‖] Chirurgical Essays.
[¶] Treatise on Ruptures.
[**] Treatise on Hernia; also Arnaud.
[††] See Scarpa.

SECTION I.

ANATOMICAL RELATIONS OF FEMORAL HERNIÆ.

The boundaries of the region concerned in **Femoral Herniæ** are formed posteriorly by the iliacus internus and psoas magnus muscles, covered by a condensed fascia, which, as it follows the course of the first named muscle, is hence called the iliac fascia. Anteriorly, we find the portion of the tendon of the external oblique muscle of the abdomen—**Poupart's ligament**—which extends from the anterior superior spinous process of the ilium to the horizontal portion of the pubis, where it is attached by a broad insertion, the exterior edge of this insertion—**Gimbernat's ligament**—forming the boundary of the opening for the passage of the femoral vessels—**femoral or crural ring**. The attachment of the anterior parietes of the abdomen to Poupart's ligament, and the continuity of these parts with the fascia of the thigh, constitute the remainder of the structures forming the front of this region. Of these, the extra-peritoneal fascia—**fascia transversalis**—in its course behind the abdominal muscles, is brought so closely in contact with the fascia covering the iliac muscle as to adhere to it, the two—**iliac and transversalis fascia**—sending a prolongation of their structure upon the course of the femoral vessels, and thus forming the commencement of their sheath. As the abdomen is a considerable cavity, and the space occupied by the escape of the femoral vessels a long and narrow one, the relations of these parts have been compared to that of a funnel, of which the abdomen forms the body and the course of the femoral vessels the spout; while the extension upon the vessels of the process of the iliac fascia behind and of the fascia transversalis in front, has given to the portions of these tissues which surround the vessels the name of **Infundibular Fascia.** It will now be readily seen that, as Poupart's ligament forms an arch in stretching from the anterior superior spinous process of the ilium to the pubis, there would be a considerable space between it and the bones—Plate XLV. Fig. 1—were it not filled up by the iliacus internus and psoas magnus muscles, and their fascia. These parts, by diminishing the distance between the anterior superior spinous process and the pubis, leave merely an opening for the vessels—**crural ring**—which is bounded behind and externally by the iliac muscle and fascia, internally by Gimbernat's ligament, and anteriorly by the fascia transversalis, as well as by the under edge of the tendon of the external oblique—**Poupart's ligament**. This opening, thus circumscribed, and giving exit to the femoral or crural vessels, is therefore correctly designated as the **femoral opening or ring**, and is the point through which a communication is established between the thigh and the cavity of the abdomen. In health, the adhesions of the surrounding parts, together with the connective tissue and lymphatic glands, close it entirely; but the action of any of the causes which would force the abdominal contents toward this point, may induce these adhesions to yield, and then the following results may be noted: The abdominal contents, being behind the peritoneal sac, must, in their course outward, press before them first a portion of the peritoneum—**hernial sac**—then the connective tissue of the opening, or the extra-peritoneal areolar tissue—**fascia propria**—in which are found the small vessels and deep lymphatic glands of the part, and when the tumor thus formed escapes from the abdomen into the course and sheath of the femoral vessels, it has no other covering except the integuments. As the psoas and iliacus muscles are on the outer side of the vessels as they pass beneath Poupart's ligament—**crural arch**—the tumor naturally tends toward the pubis—**Gimbernat's ligament**—and is, therefore, usually found on the pubic side of the vessels, the femoral vein being next to it, and the femoral artery outside of the vein, Plate XLV. Fig. 4.

If the sheath of the femoral vessels was perfect, the tumor would continue to be covered by it; but, in order to admit lymphatic vessels and the superficial veins, this sheath is perforated at numerous points—**Cribriform Fascia**—through which the tumor, by gradual distention, is enabled to escape. Here again the hernia would continue to be covered by the fascia lata of the thigh, were it not that the latter is so arranged as to permit the saphena vein to pass beneath it and join the femoral vein, and at the point—**Saphenous opening**—where this vein enters, the tumor escapes, Plate XLV. Fig. 3, and thus getting outside the fascia lata, lies directly beneath the fascia superficialis and the skin of the thigh, at a point close to but below the line of the groin, or Poupart's ligament, Plate XLV. Fig. 4.

In the minute anatomical examination of femoral herniæ, the peculiar arrangement by which the saphena vein gets through the fascia lata femoris has received considerable attention, and unfortunately been named in every possible point; thus, though all the muscles of the thigh are covered by the fascia lata, the portion of it over the sartorius muscle has been designated as the **Sartorial Fascia**, while that over the pectineus muscle is called the **Pectineal Fascia**. The sartorius muscle being also above the level of the pectineus, the portion of the fascia lata covering it is compelled to double itself and take the form of a crescent, in order to expand upon the pectineus muscle; and this crescentic margin has, therefore, been named by Burns **the Falciform Process** of the fascia lata, while the extreme point of the horn or crescent has received the appellation of **Hey's ligament.** An ordinary observer will often fail to notice these points; but a close dissection and removal of the loose connective tissue, with some traction from the knife-handle, will make them and many other little details perfectly apparent to any one who will look for them.

From the looseness of the connective tissue between the fascia superficialis and the fascia lata femoris near the pubis, this hernia is most apt to rise upward toward the groin, instead of following the downward course of the saphena vein, and it therefore approaches the outer and lower edge of Poupart's ligament.

The relations of the different parts in this region are usually simple. At the crural ring, counting from the outside of the pelvis—anterior inferior spinous process—there is first the femoral artery, then the femoral vein, then the hernia, and lastly Gimbernat's or Hey's ligament, the two being closely attached to each other. At the point where the external iliac artery becomes femoral, or directly beneath Poupart's ligament, we also usually find the epigastric artery, which, consequently, is at the outer margin of the hernial tumor, or above it.

The obturator artery, arising from the internal iliac, gets out of the pelvis at the thyroid foramen, and, sending a branch to the pectineus and adductor muscles, may therefore be at the inner side of the tumor, while the internal circumflex, if it should arise from the epigastric, would be in front of it. These arteries have sometimes arisen by a common trunk, and passed anterior to the sac before they divided.

Such an arrangement is, however, very rare; the usual relations of the vessels to the tumor being such as present the femoral vein outside, the epigastric artery also outside, but a little nearer to Poupart's ligament and the obturator artery inside, or near the edge of Gimbernat's ligament. In twenty-one preparations of crural hernia, Sir Astley Cooper found the obturator artery passing into the pelvis on the *outer* side of the neck of the sac, and therefore entirely out of the risk of injury. The femoral vein runs on the outer side of the sac, about half an inch from the centre of its orifice. Half an inch beyond the vein and exterior to it is the centre of the external iliac artery. The epigastric artery arises from the external iliac, about three-quarters of an inch from the centre of the sac, and, as it passes forward and upward, it approaches this point about a quarter of an inch nearer. The spermatic cord, or the round ligament, passes about half an inch anterior to the mouth of the hernial sac, being first situated on the outer side, and afterward crossing its fore part. The division of any stricture at these parts should, therefore, be made very slightly, but directly upward, and at the middle of the ring, especially in males, because the position of the structures at the inner and upper side of the ring might, in any other incision, expose the spermatic cord and vessels to the edge of the knife. Women being, however, by far more subject to this form of hernia than men, the division of stricture upward and a very little inward may be practiced without injuring any artery, unless the obturator is very peculiarly placed. But as variations are occasionally found in the arrangement of all the vessels near the seat of the stricture, it is a safer plan to proceed cautiously, and feel, if possible, with the finger, the portion to be nicked, or the tissues around it, before making any incision at the ring.

SECTION II.

TREATMENT OF REDUCIBLE AND STRANGULATED FEMORAL HERNIÆ.

The treatment of **Femoral Herniæ**, like those described in the other forms of hernia, consists in the Taxis, and in the division of the stricture, or herniotomy.

§ 1.—Taxis and the Application of a Truss in Femoral Hernia.

The general details of the performance of the taxis having been already given in connection with inguinal hernia, it is only necessary at present to refer to the peculiar direction in which these efforts should be made in a **Femoral Hernia.**

The greatest diameter of the tumor in a femoral hernia being transverse, in consequence of the development of the subcutaneous areolar tissue of the part permitting the tumor to expand more readily toward the anterior inferior spinous process of the ilium than in any other direction, it is generally requisite to resort to a special manipulation and position of the patient, in order to favor this operation. Thus, on flexing the thigh on the pelvis, while the patient is in the recumbent position, Poupart's ligament, or the front of the crural ring, will be made less tense in consequence of the weight of the viscera not being thrown upon the abdominal parietes; while the psoas and iliacus muscle will be less apt to compress it from behind. By adducting the limbs, or carrying the affected limb a little toward that of the other side, and by turning the toes of the foot on the hernial side very much inward, the sartorius, pectineus, and adductor muscles will be relaxed, and the parts about the saphenous opening and Hey's ligament placed in as favorable a position as possible. Therefore, when the patient is thus placed, and well etherized, it only remains for the surgeon to press the tumor gently **downward** and **inward,** in the line of the saphena vein, in order to free the hernia from the projecting edge of the falciform process of the fascia lata, or that portion which, after covering the sartorius muscles, is extended toward the pubis in order also to cover the pectineus muscle, and *then*, with the fingers of the other hand, to push it **upward** in the line of the femoral vessels, Plate XXXIX. Fig. 7. The tightness of the parts through which femoral hernia passes and the sharp edge of the constricting part render, however, every case of this kind of hernia much more dangerous than that of the inguinal region, and strangulation therefore usually supervenes much more rapidly. Less effort should also be made in the taxis of this form of hernia than in the preceding class; and when the tumor does not readily yield to the judicious application of the means just mentioned, the operation of herniotomy should be promptly resorted to in order to divide the stricture.

Trusses in Femoral Herniæ.—The directions for the application of a truss for the retention of a femoral hernia do not differ materially from those already furnished in connection with all classes of hernia, and detailed in the general account of them. Every truss should possess the characters there given, and be applied on the general principles there laid down. As the shape of a pad for femoral hernia differs, however, from that required in the inguinal class, it may prove useful to call attention to the variations noticed between these two varieties of trusses. In the truss for femoral herniæ, as the spring has to go round the pelvis in the same position which it occupied in inguinal hernia, while the seat of the protrusion is somewhat lower in the groin, and also a little more outward, it becomes necessary either to bend the point of the spring more downward and outward, or to attach the pad to it by means of a different shaped neck. As femoral herniæ also protrude beneath Poupart's ligament, while the inguinal variety is found above it, the force which acts upon the femoral pad must be applied more directly upward. The femoral pad should, therefore, be so shaped as to fill in the depression in the line of the groin as well as adapted to the inequalities of the thigh between the pectineus and sartorius muscles. With a pad formed as thus directed, with its long diameter rather more vertical or oblique than transverse, and so attached to the spring that it will press more directly upward than backward, the thigh strap may be dispensed with, and the hernia retained with much less difficulty than in the inguinal hernia, as there are in this region less bony inequalities than are found nearer to the pubis.

The radical cure of femoral herniæ by an operation has seldom been attempted, owing to the proximity of the femoral and epigastric vessels, as well as the other peculiarities of the sac, etc. in this variety of hernia.

§ 2.—Herniotomy in Strangulated Femoral Hernia.

As the tumor in a **femoral hernia** is formed by the sac and its contents escaping at the saphenous opening, and then rising up toward Poupart's ligament, it usually presents itself a little below the line of the groin. In order to expose its contents, various modes of proceeding have been recommended, all based on the general direction of incising the integuments in a line parallel with the great diameter of the tumor. In the external incision, this direction has been slightly modified by different surgeons; thus, Sir Astley Cooper advised that the skin, after being shaved, should be cut directly over the middle of the tumor, in a line nearly corresponding with the line of the groin, the incision being extended from the groin to a point a few lines below the lowest part of the tumor, either by picking up a fold of integument and dividing it with the bistoury by transfixing it, or, if the

PLATE XLV.

PARTS CONCERNED IN THE OPERATION FOR FEMORAL HERNIÆ.

Fig. 1. Position of the Crural Ring with the attachment of Poupart's Ligament. 1. Anterior superior spinous process. 2. Ilio pectineal ridge. 3. Femoral ring. 4. Septum between the femoral vessels and the iliac muscles diminishing the size of the crural arch. 5. Poupart's ligament. 6. Anterior inferior spinous process. *After Bernard and Huette.*

Fig. 2. A view of the relations of the Superficial Fascia to Femoral Herniæ. 1. External oblique muscle. 2. Its tendon cleared of the fascia. 3. Fascia lata femoris. 4, 4. Superficial femoral fascia everted. 5. Cribriform structure for transmission of lymphatics. 6, 6. Superficial vessels. *After Bernard and Huette.*

Fig. 3. A view of the deeper seated parts of the same region. 1. The external oblique muscle. 2. Its tendon. 3. The fascia lata. 4. Its cribriform structure raised up. 5. Sheath of the vessels. 6. Femoral artery. 7. Femoral vein. 8. Saphena vein. *After Bernard and Huette.*

Fig. 4. Positions and relations of a Femoral Hernia. 1. Integuments of the abdomen. 2. Tendon of the external oblique. 3. The muscle. 4. The spermatic cord. 5. Femoral artery. 6. Femoral vein. 7. Intestine protruding at the saphenous opening. 8. Hernial sac. 9. Sartorius muscle. 10. Pectineus muscle. *After Bernard and Huette.*

Fig. 5. Position of a Double Hernial Sac. 1, 1. The ring. 2. Fundus of the principal sac. 3, 3. Cavity of the peritoneum. 4. Fundus of the second sac. *After Bernard and Huette.*

Fig. 6. Commencement of the formation of an Artificial Anus, showing the relations of the Mesentery to the protruding knuckle. 1. Ring. 2. Intestine. 3. Mesentery. *After Bernard and Huette.*

Fig. 7. Relative position of the Vessels in Inguinal and Femoral Herniæ. 1. Tendon of external oblique. 2. Poupart's ligament. 3. Psoas and iliacus muscle in the course to their insertion. 4. Femoral artery. 5. Femoral vein. 6. Spermatic cord. *After Bernard and Huette.*

Fig. 8. A posterior view of the reflections of the Peritoneum upon the Abdominal Parietes. 1. Bladder. 2. Reflection of the peritoneum over the round ligament of the bladder. 3. Reflection over the same on the opposite side. 4. Reflection over the urachus. 5. Position of an indirect inguinal hernia. 6. An oblique inguinal hernia. 7. A ventro-inguinal hernia. 8. The femoral artery. 9. The femoral vein. *After Bernard and Huette.*

Plate 45.

Fig. 1.

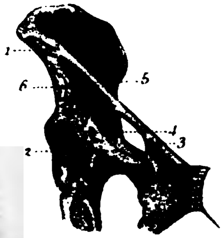


Fig. 2.

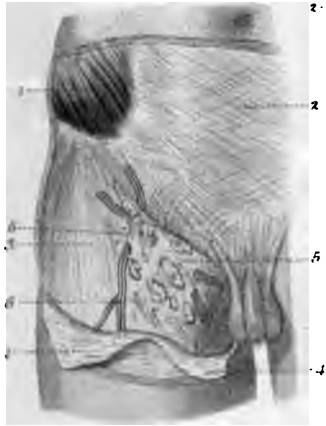


Fig. 3.

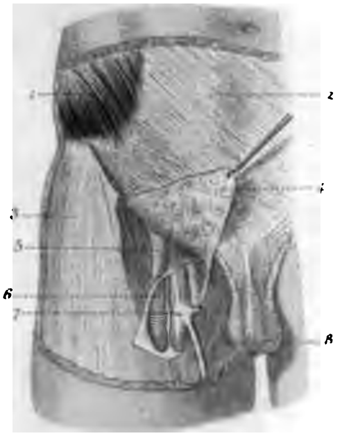


Fig. 4.

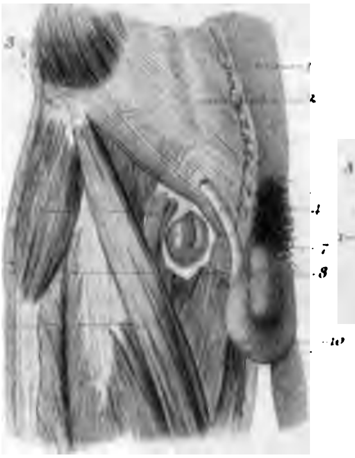


Fig. 5.

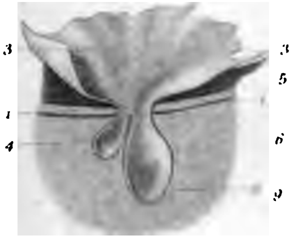


Fig. 6.

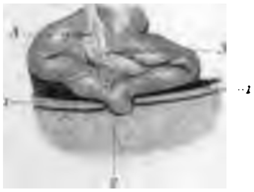


Fig. 7.

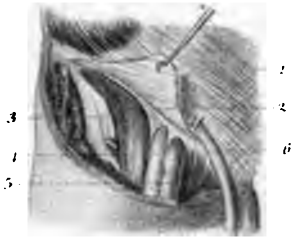
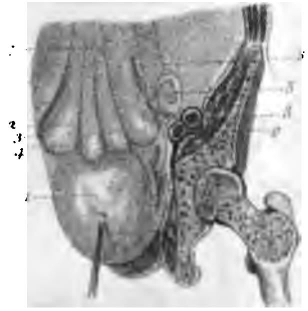


Fig. 8.



tumor was so large as to render the skin tense and difficult to raise, by incising it with the scalpel as in an ordinary dissection. When the tumor is small, or not larger than an egg, a single incision may suffice to open the skin over it; but in larger protrusions, or in those found in corpulent patients, it will be better to make a transverse cut at the base of the first, like a reversed ⊥, so as to dissect off the two flaps laterally. The saphena vein, being behind and at the outside of the tumor, is not likely to be involved in this manner of operating.

Pelletan and Dupuytren preferred a crucial cut for the division of the skin, and Lawrence one which, beginning an inch above the crural ring, ran obliquely downward and outward. After freeing the skin, the superficial fascia may be recognized by its containing several inguinal glands together with more or less fat, and from infiltration or other causes is often quite thick. In order to divide it, as well as the fascia propria, or, in order to divide safely every structure between the skin and the sac, each layer should be separately elevated by the forceps, and the portion raised incised by placing the blade of the knife flat to the surface of the tumor, so as to nick its coverings. The director being then passed into the opening and beneath the layer, the probe-pointed bistoury should be carried along the groove of the instrument until the parts are laid open to near the same extent as in the first incision. On reaching the sac, which may usually be recognized by the characters spoken of in connection with inguinal hernia, it should be cautiously raised at the more depending portion of the tumor, where the serum usually found within it naturally gravitates and separates the peritoneum from the intestines; but, as the amount of fluid in the sac in femoral hernia is much less than that found in the inguinal variety, more caution is requisite, because the sac being much nearer to the contents of the tumor, the latter are more liable to be wounded. A nick being now made in the portion raised in the forceps, a director should be introduced, and a bistoury carefully passed along it, so as to open the sac freely in a manner similar to that pursued in the division of the other layers. On exposing the contents of the tumor, pass in the forefinger of the left hand and feel for the seat of the stricture, which may generally be found as a sharp and defined edge near the interior and inferior portion of the circumference of the ring, or at the points corresponding with Hey's ligament—point of crescentic edge of falciform process of the fascia lata femoris—or at the saphenous opening, or deeper and higher in the wound at the seat of Gimbernat's ligament. On finding the stricture, pass the point of the probe-pointed bistoury beneath it, in the manner directed for the same step in inguinal hernia; or, if the stricture is so close as to prevent the use of the forefinger, resort to the director found in the pocket-case, or to a spatula, and thus protecting the bowel, get the bistoury flatwise beneath the constricting margin, turn its edge up and nick the stricture very slightly upward, if it is introduced at the middle of the ring, or upward and a little inward, if the nick is to be made at its inner margin. But the best direction for dividing the stricture has been a point on which surgeons have often differed. Lawrence states that Dupuytren and Richerand preferred an incision upward and outward; Gimbernat advised the nicking of the edge of the ligament named after him; and Hey the incisions of the most interior part of the stricture.

In order to comprehend these different opinions on a point which it might be supposed would be certainly settled by daily observation, the varying course of the obturator and epigastric arteries should be recollected, as well as the tendency in all operators to insist upon the observation of certain fixed rules, which are often predicated only on their own modes of demonstrating the anatomical relations of the part. As the stricture may generally be overcome simply by pressure, after its thick, sharp edge has been nicked, to speak of the cut that is produced by the edge of the bistoury as a division is liable to mislead, as the so-called division of the stricture is in most cases only a notch in its edge, which is intended to facilitate such subsequent laceration as will permit the restoration of the contents of the tumor. The use of a dull bistoury, and the direction of its edge upward for merely a line at several points of the ring, as advised by Velpeau, no matter in what portion of the circumference of the ring the stricture is most marked, will suffice for the relief of the constriction, as may be readily tested on any subject

The stricture being divided, the condition of the contents of the sac should be inspected and treated as directed for inguinal herniæ, after which the wound should be closed by a suture, adhesive strips, cerate, compress and bandage, and the diet regulated as before directed.

Complications of Femoral Herniæ.—Femoral hernia, from its peculiar position, is liable to mislead the surgeon in his diagnosis, and also to confuse him in operating, in consequence of the changes produced by various causes in the surrounding inguinal glands and vessels. Buboes, aneurism, hydatid cysts, foreign bodies—as needles—psoas abscesses, or one or more sacs, or the retention of the hernia in the sheath of the femoral vessels, and its being covered by the fascia lata, are all cases that have been recorded, and may, therefore, reasonably be expected to present themselves again. The frequency of the position of the obturator artery on the front or inner side of the tumor at the seat of stricture, as is the case when it arises from the epigastric artery, is quite marked, it having been found by Cloquet, after examining two hundred and fifty subjects, one-half of which were females, to be thus situated about once in every three cases.

Owing to these circumstances, the operation on a femoral hernia is usually regarded as more dangerous than that performed for the relief of strangulated inguinal herniæ; but with the anatomical knowledge that should be possessed by every surgeon, and with proper caution and coolness, this operation cannot be considered as an especially difficult one. With a patient in a state of anæsthesia there need certainly be no haste, even if the operator should deem it right under other circumstances; and if the incisions are slowly and cautiously performed, they will doubtless be safely done. Should a severe hemorrhage result, which cannot be traced directly to a wounded vessel, the introduction of a small linen sac into the crural ring, and the subsequent stuffing of it with lint or cotton, so as to press like a finger on the bleeding point for a few days, as advised by Boyer, may suffice to arrest it.

§ 3.—Statistics of the Operation of Herniotomy in Strangulated Femoral Herniae.

A reference to the subjoined table will prove that the operation for femoral herniæ has certainly succeeded better than most surgical operations, and practice will probably satisfy any medical man that the difficulties of it have been much exaggerated.

Statistics of the Result of Herniotomy in Strangulated Femoral Herniæ.

	Cases.	Cured.	Died.
Gimbernat*	4	4	0
Lawrence†	6	6	0
Scarpa‡	2	1	1
Monro, Sen.§	4	4	0
C. Bell‖	1	1	0
	17	16	1

All but one of these operations were reported as successful.

CHAPTER VII.

UMBILICAL HERNIÆ.

THE term **Umbilical Hernia** being generally applied to such protrusions of the abdominal contents as occur immediately in the neighborhood of the umbilicus, as well as to those seen directly in the course of the vessels of the cord, there is a liability to error as regards the seat of this class of tumors, if the surgeon does not recall the difference shown in the structure of the part, as seen in the infant and as found in the adult. This difference, having been referred to in the general account of the complaint, need only be here briefly hinted at. In the infant, umbilical herniæ may protrude either beneath the skin at the margin of the umbilicus, or a little further on along the cord, where it is usually surrounded simply by the envelopes of the latter. In the adult, these vessels having been removed, and the surrounding parts firmly cicatrized, a hernia can only escape by distending some of the openings in the linea alba directly around this firm cicatrix, the appearances of which must be familiar to every dissector. These openings being generally on one side of the umbilicus, the point of protrusion is often situated near the superior portion of the circle. As a hernia tends to sink by its own weight, the opening into the abdomen will often be found enlarged and depressed, and thus lead a careless observer to think that the tumor has really escaped at the space left for the vessels of the umbilical cord or below it.

SECTION I.

SURGICAL ANATOMY.

After the **umbilical vessels** have entered the abdomen of the fœtus at the opening left for them in the linea alba, the arteries run downward toward

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[*] New Method of Operating for Femoral Hernia, by Antonio de Gimbernat.

[†] Lawrence on Ruptures.

[‡] Treatise on Hernia, by Antonio Scarpa.

[§] Observations on Crural Hernia, by A. Monro, Sen.

[‖] Operations for Strangulated Hernia.

the bladder, while the vein courses over to the right side along the free margin of the suspensory ligament, to enter the umbilical fissure of the liver, where it terminates in the left sinus of the vena portarum. Like the other blood-vessels in the abdomen, the umbilical arteries and vein are on the outside of the peritoneal sac, and do not perforate this membrane; consequently, any protrusion of a viscus at this point must be covered by a layer of the peritoneum, and have, at least in its early stages, a perfect sac like the other herniæ. The variety of opinions on this point, and especially those of the distinguished surgeons who have doubted the existence of a sac, may therefore all be explained by the fact that, under distention, the sac may be perforated, as related by Sir Astley Cooper, or gradually thinned or absorbed as mentioned by Monro and others.

The pressure of large and old herniæ in the adult may also lead to a similar diminution in the density of the fascia superficialis abdominis, or even the skin; a case being related by Arnaud "in which the bowel adhered so closely to the skin as to cause it to be cut in dissecting the parts after death." No blood-vessels are situated near the course of a hernia in this region, except it may be abnormal veins, as have been seen by Manec, Maniere, and Velpeau.

As the opening through which umbilical herniæ escape is altogether in the linea alba, there is no umbilical canal, nor is there much liability to the production of a stricture at the neck of the sac.

SECTION II.

TREATMENT OF UMBILICAL HERNIÆ.

§ 1.—Of the Palliative Treatment of Umbilical Herniae.

The treatment of umbilical herniæ requiring that the contents of the tumor should be pressed into the abdomen as soon as possible after their escape, in order to facilitate the cure, the taxis may, in reducible cases, be readily accomplished by inducing a perfect state of anæsthesia, and then manipulating the tumor so as to bring it to the level of the ring, after which, portion after portion should be restored by the action of the thumb and fingers, as described in the inguinal form of herniæ, except that the contents of the tumor should here be pressed directly toward the spine, and then a little upward, as the mouth of the sac is not in the centre of the tumor, but a little above it. Having thus succeeded in entirely restoring the protrusion, it remains to decide whether it will be desirable to attempt only a palliative cure by the application of a truss, or resort to the more severe operation that has occasionally been employed in the attempts at a radical cure.

The **Truss** that is employed for the palliative treatment of umbilical herniæ will differ somewhat according to the age of the patient. In infants, soon after birth, or within the first eighteen months, the application of a compress formed by firmly wrapping a cent or half dollar in linen so as to form a pad, and confining it to the part by the ordinary flannel belly-band, or by adhesive strips, is all that is requisite; but in the adult, the application of the ordinary umbilical pad and truss of the shops will answer, the structure of the pad being of less consequence in this form of herniæ than in the preceding varieties. If the hernia is large, it will prove useful to add the ordinary laced bandage of the abdomen to the use of the truss, in order to support the abdominal parietes more thoroughly, and prevent the lateral separation of the linea alba. This separation is sometimes so great that, in one female subject that I dissected, the linea alba was open from near the pubes to half-way between the ensiform cartilage and the umbilicus, the umbilical ring being nearly three inches in diameter, and the intestines supported only by the skin and superficial fascia, the latter being very much thickened.

§ 2.—The Radical Cure of Umbilical Herniae.

The radical cure of an **umbilical hernia** has been often accomplished in the young subject, both by an operation and also by the use of the compress or truss. It should generally be attempted in every case of this form of hernia in children, because in adults the attempt is of very doubtful utility.

Desault's Operation.—The child being laid on its back, with the thighs somewhat bent and the head inclined forward, return the protruded viscera, and press upon the opening with one hand while you raise the sac with the other, so as to ascertain that no part remains unreduced; then, passing a waxed ligature several times around the base of the tumor, including both the integuments and sac as held in the fingers, secure each turn with a double knot, drawn tight enough to occasion an inconsiderable degree of pain, and cover the tumor with lint, over which compresses are to be applied and secured by a bandage and shoulder-straps. In a day or two after the first ligature is applied, the shrinking of the parts will require the application of a second ligature, which should be tied considerably tighter, and even a third may become necessary after a few days. In eight or ten days the tumor (skin and sac) will slough off, and leave a small ulcer, which speedily heals, after which a truss or compress should be worn for several months. The probability of the cure diminishes with the age of the child, and in a girl nine years old it failed entirely in Desault's hands. In a case operated on by Joseph Parrish, of Philadelphia, the patient was cured,* though the slough of the integuments did not separate until the seventeenth day.

Operation of Physick, of Philadelphia.—In a large umbilical hernia, Physick proposed to effect a radical cure by opening the integuments by a crucial incision as far as the neck of the sac, and then opening the upper part of the sac so as to see its contents, reducing them, if possible, without dilating the ring; but when this could not be done, to divide the stricture outside of the sac. After reducing the contents, he suggested that a ligature should be drawn around the neck of the sac, with a view of closing its cavity.

Remarks.—This operation was proposed by Physick, but never performed by him, though Wistar is reported to have thus operated with success. In a case subsequently operated on by Gibson, of Philadelphia, death, however, ensued. Sir A. Cooper has succeeded by similar means in two cases;† but subsequently he, together with Scarpa, Benedict, Richerand, and others, rejected it on account of the pain and inflammation it created, as well as from the fact that pressure alone was generally able to accomplish the cure. In most cases of herniotomy in the adult, the application of a ligature around the neck of the sac should be omitted, and the restoration of the parts without opening the sac avoided, as this exposes the patient to death from internal strangulation, as was referred to in the restoration of hernia in mass.

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* Parrish on Hernia, p. 190.
† Lawrence, p. 489.

§ 3.—Herniotomy in Strangulated Umbilical Herniae.

The existence of **Strangulated Umbilical Herniæ** being rare, except in the cases of adult females, the description of the operation may be confined to this class of patients.

Operation.—The patient being placed in the recumbent position, and the proper preliminary steps taken, pick up a fold of the skin, if it is loose, and, rubbing it between the fingers, so as to be sure that no other tissue is included, incise it with the bistoury from within outward as before directed. But if, as is often the case, all the coverings of the tumor are evidently thinned, then the incision should be made in the line of the linea alba by light touches of the scalpel from without inward, the size of the tumor regulating the selection either of a crucial, ┬, or ┴ incision. On opening and dissecting back the skin sufficiently to expose the part to a moderate extent, the remaining tissues—to wit, superficial fascia, fascia propria, and sac, or such of them as can be made out—should be most cautiously divided, as detailed in the preceding classes of herniæ, and any portion of the umbilical ring or opening in the linea alba nicked to a sufficient extent by means of a director and probe pointed bistoury, the intestine or omentum being then treated as circumstances may indicate, after which the flaps should be united and dressed as directed in femoral hernia.

Artificial anus, though rare, may occur at the umbilicus as elsewhere, and be cured solely by cicatrization, of which an example has been cited by R. G. Wharton, of Mississippi, as occurring in a negro child a few days after birth. Amyand, Pelletan, Scarpa, and others have also seen this condition of the part in the adult; but there is greater difficulty in healing it at this point than elsewhere, owing to the adhesions of the intestine to the abdominal parietes, and the absence of a canal like that seen in the groin.

Statistics of the Result of Herniotomy in Strangulated Umbilical Herniæ.

	Cases.	Cured.	Died.
Lawrence	3	2	1
Scarpa	1	1	0
Desault	3	3	0
	7	6	1

From this it appears that, out of seven cases operated on, only one died; and, though representing a small number, this is probably a correct estimate of, or at least an approximation to, the success of the operation in this form of hernia.

Summary of the Operations for Herniotomy in the three forms of Strangulated Hernia.

	Cases.	Cured.	Died.	Artificial anus.
Inguinal	49	34	14	1
Femoral	17	16	1	
Umbilical	7	6	1	

On examining the total of the cases thus collected, it is seen that the cures of **Inguinal Herniæ** were only about two-thirds of those operated on, while in **Femoral** and **Umbilical** all but two were cured. The explanation of this difference must be a matter of conjecture; but the facts, which have been carefully collected during an examination of the sources before mentioned, in the general references throughout the subject of **Herniæ**, are those now shown.

§ 4.—Frequency of the Forms of Herniae.

From a statement made by Lawrence, as based on the records of the London Truss Society, for twenty-eight years, it appears that of about 84,000 patients, nearly 68,000 were males, and about 16,000 females. Of these, 39,419 were inguinal herniæ, 6210 femoral, 2775 umbilical, 413 ventral, and 4 obturator herniæ.

CHAPTER VIII.

ARTIFICIAL ANUS.

Artificial Anus is the name applied to two distinct conditions of the body, in one of which an opening is formed by nature from the bowels through the skin, in consequence of the mortification resulting from a strangulated hernia, while in the other, the opening is made by the surgeon from the skin to the bowel, in order to give exit to such fecal contents as may have been prevented by various causes from escaping at the orifice of the rectum. As the occurrence of the artificial anus which ensues from strangulation of the intestinal contents of a hernia is the most frequent, and also that most directly connected with the preceding subject, it may properly receive the first consideration.

SECTION I.

ARTIFICIAL ANUS RESULTING FROM MORTIFIED INTESTINE.

Pathology.—When a portion of the intestine has been so strangulated at the seat of stricture as to lose its vitality and run into sphacelation, the dead portion is sometimes so limited that nature can throw it off in the form of a slough, and thus leave the bowel defective in its parietes. In the effort of nature to separate the dead portion, sufficient inflammation is usually excited in the surrounding parts to glue the gut fast to the sides of the ring through which it has been protruded, or to the abdominal parietes nearest to it, so that after the slough of the bowel has separated, the fecal contents pass directly outward to the skin, where an ulcer is developed that may present either one moderate sore with a fistulous orifice, or numerous openings of the same character. When the point of a knuckle of intestine, like that found in the hernial sac, is the seat of the slough, the opening through the anterior intestinal parietes gives to the part the appearance of a double-barreled gun, the septum between the two sections of intestine being composed of that portion of the gut to which the mesentery is attached, Plate XL. Fig. 6. But if, instead of a knuckle of intestine, it is the parietes of a straight portion of the gut which is opened, then there will be but a single tube, Plate XL. Fig. 7. When the opening in the integuments is large, there is also a tendency in the mucous coat of the gut to prolapse, in consequence of which a tumor formed by the everted mucous membrane is found at the orifice in the skin. The double-barreled variety of artificial anus requires that the septum which separates the two ends of intestine should be removed, in order to allow the fecal contents to pass from one tube into the other, without escaping from the end of the upper barrel; but the single-barreled variety, or that formed by a single piece of intestine, demands merely the closing of the opening in the parietes, in order to fit the gut for the transmission of its ordinary contents. The treatment of these two forms of the complaint is therefore quite different, the first demanding the closure of the orifice until nature can heal it, the second requiring the destruction of the septum spur or buttress found between the two compartments. Owing to the ulceration of the intestinal parietes extending each way, it occasionally happens that the anterior edge of the septum projects, and materially interrupts the regular course of the contents of the bowels. To relieve such cases, Desault resorted to pressure, which was applied against the anterior edge of the septum, both in order to force it backward and also to compress it, tents and similar means being introduced through the external orifice.

Physick, having noticed that the existence of the septum between the two tubes of a knuckle of that intestine in which the artificial anus existed was the great obstacle to the downward course of the fecal matter, decided to induce sufficient inflammation to glue together the adjoining peritoneal surfaces of the gut, and then, when they were adherent, to cut away the septum, which he did in the following manner:—

Operation of Physick, of Philadelphia.—Having, in January, 1809, passed a ligature through the septum in the intestine of Jno. Axillius, a patient in the Pennsylvania Hospital, and thus formed a loop, he drew the ligature moderately tight by tying it upon the anterior edge of the septum, allowing the thread to remain one week, so as to keep the two sides of the bowel in close contact. Then cutting away a portion of the septum at the point of union of the sides, so as to create a hole, and stopping the anterior or external orifice, the feces resumed their natural channel, and the patient recovered.*

Operation of Dupuytren.—In 1813, Dupuytren resorted to the operation proposed by a German surgeon named Schmakhalden, in an inaugural essay which he made public in 1798, to wit: to cut through the intestinal septum by means of a ligature passed through it by a curved needle, when, traction being made upon the ligature, it gradually cut its way out in a longitudinal direction, as is the case in the treatment of fistula in ano. Finding that there was risk of the needle going beyond the projecting adhesions, and opening a portion of the tube communicating with the cavity of the peritoneum, Dupuytren resorted to pressure of the two peritoneal coats of the intestinal knuckle, in order thus to induce inflammatory action. To accomplish this, he invented an **enterotome**—Plate XXXV. Fig. 18—which acted like a pair of forceps, the blades of the instrument being closed by a screw in the handles, which he employed as follows: After placing the patient in the position for the operation of strangulated hernia, he exposed the two orifices of the intestine by passing in two fingers or two female catheters, and turning them over each other; the resistance to their approximation indicating the position of the septum. Then taking one branch of the enterotome, he passed it along the sound to the depth of two inches or more, according to the projection of the septum, and let an assistant hold it while the other blade was introduced in the same manner and to the same depth into the other orifice. Then gently turning the screw at the handles, so as to compress the portion of intestine between the blades—Plate XL. Fig. 2—colicky pain supervened, but usually soon pass off, though each turn of the screw seemed liable to produce the same pain. As the length of the parallelism of the tube was increased, solid adhesion of the two sides was induced, and about the eighth day the instrument became movable and fell off, leaving a brown, dry eschar in the wound, of the same length as the portion compressed by the instrument. When this separated, the remainder of the septum was felt as a hard and undulated ridge at each side of the opening, through which the passage of the feces was favored by the free use of enemata.*

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* Dorsey's Surgery, vol. ii. p. 96; also North Am. Med. and Surg. Journ., vol. ii. p. 269, in a paper by Benj. H. Coates, M.D.

After-Treatment.—After both the operations just described, the opening left in the integuments requires careful treatment, in order to favor its closure; and this may be attempted by the use of such means as will favor the healing of fistulous orifices generally, such as cauterization by the nitrate of silver or sulphate of copper, or by compression, or the quilled suture, or by anaplasty. In most cases, a certain amount of pressure upon the abdominal parietes near the seat of the opening will prove useful, and I have more than once seen great benefit derived from the application of a truss over a greased compress placed upon the ulcer, after cauterization by sulphate of copper.

Operation of J. R. Lotz, of Pennsylvania.†—An ingenious modification of the instrument and operation of Dupuytren has been made by Lotz, of New Berlin, Pennsylvania. His instrument consists of two blades with fenestra, each of which is about an inch long and a quarter of an inch wide, and surrounded by a solid rim about a line thick, the whole length of the instrument being about six inches, and its weight nine drachms.

Fig. 426.

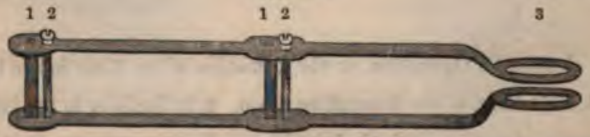

Fig. 426.—A side view of Lotz's instrument for the cure of Artificial Anus. 1, 1. Pins to keep the blades parallel. 2, 2. Screws to approximate the blades. 3. The fenestrated branches that compress the "speron," or spur-like process of the intestine. After union has been induced by the compression of the coats of the bowel, the intermediate portion can be cut by a bistoury passed through the fenestra. The blades are introduced separately into the intestine, and subsequently closed and approximated by the screws. (After the instrument.)

Operation.—The two blades, being introduced separately, are to be brought together and closed by means of two screws, so as to preserve the parallelism of the blades, after which the plates may be gradually approximated or slackened, according as they induce pain or nausea. On the third day after the introduction of the plates, the patient having continued comfortable, the portion of bowel compressed between the fenestra may be divided by means of a gum lancet, and an opening at once established in the septum at the point which corresponds with that existing in the blades of the instrument. The compression being now gradually removed, as it had been gradually applied, the instrument may be taken away, when the patient will be found to have a smooth, round hole, of about the dimension of an inch, with the sides of the bowel firmly adherent all round it.

Operation of J. Mason Warren, of Boston.—A female, aged thirty-four

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* Malgaigne, p. 428. Philad. edit.

† Am. Journ. Med. Sciences, vol. xviii. p. 367.

PLATE XLVI.

A VIEW OF THE OPERATION FOR THE FORMATION OF AN ARTIFICIAL ANUS.

Fig. 1. A front view of the surgical relations of the Colon. 1. Integuments. 2. External oblique muscle. 3. Internal oblique. 4. Transversalis muscle. 5. Lower edge of the liver. 6. Distended cæcum. 7. Transverse colon. 8. Descending colon, with sigmoid flexure seen below. *After Bernard and Huette.*

Fig. 2. A posterior view of the parts concerned, as shown by removing the dorsal structures. 1. The peritoneum. 2. The kidney. 3. The mesentery. 4. The bowels. 5. The colon. 6. The spine. *After Bernard and Huette.*

Fig. 3. Littre's Operation for the formation of an Artificial Anus at the right groin. 1, 1. Outline of the colon. 2, 2. Extent of the inguinal incision in the integuments. 3. An instrument passed beneath the distended colon in order to bring it to the front of the wound. 4. The point of the bowel which is to be perforated. *After Bernard and Huette.*

Fig. 4. Amussat's Operation, or the formation of an Anus in the left lumbar region. 1, 1. Outline of the descending colon. 2, 2. Incision in the integuments. 3. Instrument placed beneath the bowel to render it prominent. 4, 4. Ligatures passed through the bowel in order to attach it to the sides of the wound before it is perforated. *After Bernard and Huette.*

Fig. 5. Shape and appearance of the Anus formed by Littre's Operation. The long diameter of the opening corresponds to the line of the groin, and the bowel is so attached to the edges of the incision in the abdomen as to prevent contraction of the orifice or the escape of the bowel into the abdomen.

After Bernard and Huette.

Fig. 6. Appearance of the Artificial Anus formed in Amussat's Operation, showing the position of the sutures and the character of the opening.

After Bernard and Huette.

Plate 46.

Fig 1.

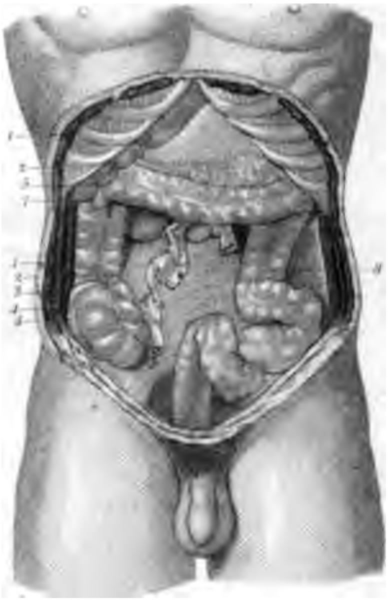


Fig 2.

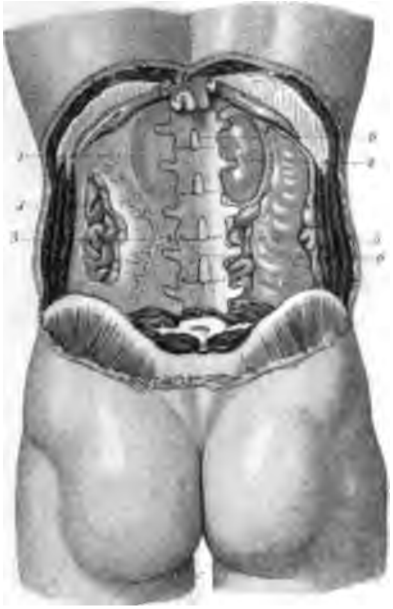


Fig 5.

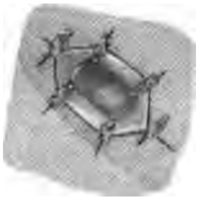


Fig 6.

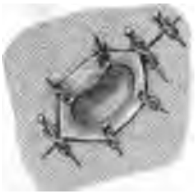


Fig 3.

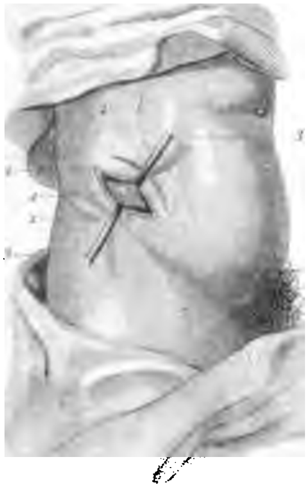
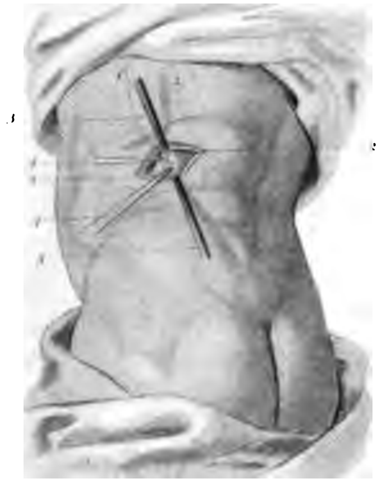


Fig 4.



years, in whom an artificial anus formed after strangulation of a crural hernia of the right side, the feces, in a very liquid state, were constantly running out through two openings in the groin, and three in the posterior part of the thigh; the limb being drawn up nearly to a right angle with the body, and the whole thigh much enlarged and hardened. The skin was also thickened almost to callosity, and excoriated, and the openings were so small as hardly to admit a common director. To relieve this, Warren operated in the following manner:—

Operation.—After dilating the principal openings by sponge-tents, applied very gradually, and continued for a month, the two ends of the intestine were discovered. A gum-elastic bougie being then passed into the upper orifice, and another into the lower, the two were made to penetrate a thick callous mass of integument, and then passed through the abdominal parietes for about an inch, when the septum or spur which separated the two ends of the bowel was encountered and with difficulty entered, being so closely applied to the abdominal parietes as to prevent the least passage of matter from the upper into the lower part of the bowel. As the intestinal ends seemed to lie parallel to one another, the exploring bougies made a very slight angle at their extremities.

Having now made sure of the position of the lower opening by the introduction of a director, the male branch of Dupuytren's enterotome was carried into the lower intestine, the director withdrawn, and the female branch readily introduced into the upper; but as the two parts of the instrument occupied nearly the whole calibre of the dilated passage leading to the gut, it was necessary to separate and loosen them, and this was found to be impossible, as the jaws of the female portion would not allow of sufficient motion at the hinge to lock with the other blade.

This instrument was therefore withdrawn, and another, which was about two inches shorter than Dupuytren's, introduced; but this instrument, instead of having one blade received into a groove in the other, was serrated like polypus forceps for the space of three inches. The blades being now introduced and locked without difficulty, were therefore at once brought together as tightly as the screw would permit. For a few hours the patient complained, but next day was free from pain; the fecal matter passed by the side of the instrument; warm water was injected daily into the wound to prevent any obstruction, and she also had an enema administered, to keep the lower bowel in action.

Three days after its application the instrument came away, bringing with it a blackish slough two inches and a half long, four lines wide, and about three thick, which had the impress of the teeth of the instrument.

The finger being now passed into the orifice, readily distinguished an opening between the two ends of the intestine, corresponding in size to the slough, the edges of which were greatly thickened and fleshy, and unlike the delicate valvular septum which previously existed.

On the following day there was a discharge per anum; a compress was applied to the orifice of the wound, and the patient ultimately recovered.

§ 1.—Statistics of Artificial Anus.

According to Dupuytren, the following is the result of his experience in artificial anus:—

Of forty-one cases treated by himself and others, thirty-eight were cured, and three died.

Of the thirty-eight cured, twenty-nine were radically cured in from two to six months, and the remaining nine continued to suffer from fistulous orifices, notwithstanding every effort to heal them. The mortality following the use of his enterotome was one in fourteen.

Remarks.—As the palliative treatment of artificial anus, when consequent on strangulated hernia, affords only temporary relief, and is the result of the application of a compress or truss to the ulcer at the external orifice, such means do not require much notice; but as the radical cure, by the means above detailed, was an operation which relieved the patient from a most loathsome complaint, it naturally excited considerable attention at the period when it was introduced; and the claims to priority of invention on the part of Physick and Dupuytren have, therefore, been strongly contested. In the United States, no one questions the originality of the operation of Physick, the thesis of Schmakhalden having, in all probability, been limited in its circulation, and not extended to a country the intercourse of which with Europe was at that time very limited. But, while advocating the rights of Physick, the advantages of each mode of operating need not be overlooked. From an examination of various facts, there is good reason to think that, from the different degrees of obliquity seen in the two tubes in different instances, the selection of any operation must be decided by the peculiarities of the case. As a general rule, I would give the preference to the instrument of Lotz, of Pennsylvania, (which is, as has been shown, a modification of that of Dupuytren,) in all cases where the two tubes are not perfectly parallel; but when they are thus situated, the operation of Physick has the following advantages over that of Dupuytren:—

1st. There is no inconvenience caused to the patient, by having an instrument projecting from a tender ulcer during the period of eight days.

2d. There is a better chance of exciting solely adhesive inflammation by the use of the ligature, than there is by compressing the structure, the slough created by the instrument of Dupuytren being liable to extend beyond the width of the blades of the instrument.

3d. The division of the septum by a cutting instrument, as practiced by Physick, is preferable to the irregular orifice produced by the separation of the slough formed between the blades of the enterotome of Dupuytren.

In cases where the obliquity of the bowel does not present anything like an intermediate or double-barreled septum, neither of the preceding operations for the radical cure would be available, the treatment in this case requiring merely a palliative operation, or such a one as would favor the contraction and cicatrization of the orifice in the intestine as well as in the skin.

SECTION II.

FORMATION OF AN ARTIFICIAL ANUS.

The formation of an artificial anus, in order to give vent to such contents of a bowel as have been prevented from pursuing their natural course, either in consequence of a congenital defect of the natural anus, or by the development of an obstruction in the lower part of the intestinal canal, is purely the result of surgical skill, based upon an accurate anatomical knowledge of the position of the portions of the canal which are best adapted for the safe formation of such a vent as will give exit to fecal matter with the least possible inconvenience to the patient.

Without alluding to the various causes which may render this operation necessary, or explaining at present the steps of such methods as are demanded by congenital occlusions of the rectum, it is proposed to call the reader's attention to two operations, in both of which the intestine is opened at points more or less closely connected with the regions at which hernia may be developed.

§ 1.—Formation of an Artificial Anus at the Groin.

As the details of the relative position of the abdominal viscera to the groin were presented in connection with hernia, there is but little occasion for more than a brief allusion to the part of the intestine usually opened in the formation of an artificial anus.

The colon, arising in the right iliac region by the cæcum, passes upward on the right side, as high as the lower portion of the right hypochondriac region, then transversely through the lower portion of the epigastric region and across the abdomen, to the lower portion of the left lumbar region, when it descends to the left iliac region, where it terminates by the sigmoid flexure. As the groin presents a point to which the attention of the patient may be readily given, it has generally been regarded as furnishing the most favorable point for the formation of an opening, which must subsequently be closed by artificial means, and which must require the patient's personal attention, in order to preserve proper cleanliness. At these points the cæcum or the sigmoid flexure is covered only by the abdominal parietes, Plate XLVI. Fig. 1. Thus we find the skin, superficial fascia, tendon of the external oblique muscle of the abdomen, internal oblique and transversalis muscles, fascia transversalis, and peritoneum presenting here the same relative layers that have been referred to in connection with hernia. Through these layers, an incision should therefore be made in such a direction as would present the long diameter of the wound in the line of the groin, the intestine attached to the sides of the wound, and then such a perforation practiced on its coats as will permit the subsequent contraction of the parts, and give sufficient vent to the obstructed contents of the bowels.

This operation dates back to the year 1720, when it was suggested by Littre,* since which period it has been performed by many other surgeons; some of whom, either through ignorance or inadvertence of the proposition of Littre, have considered themselves as the originators of the idea.

Operation of Littre.—The patient being placed upon the back, with the thighs extended, and the surgeon standing in a position similar to that demanded for the operation of strangulated hernia, commence the incision on a level with the anterior superior spinous process of the ileum, and carry it inward and downward toward the pubis, in the line of the groin, for the extent of two or two and a half inches. After incising the skin and superficial fascia, make a small opening in the tendon of the external oblique, pass in a director, and incise the tendon upon the latter instrument by means of a probe-pointed bistoury. After incising in a similar manner the fibres of the internal oblique and transversalis muscles, and tying any branch of the circumflex iliac artery that accident may bring into the line of the incision, next cautiously divide the fascia transversalis, and then with the same caution the peritoneum, incising both upon the director or finger in order to avoid the intestines. If the gut, which is usually distended with feces, now presents itself, it may be distinguished from the small intestines by its reddened color, if congested, or by the yellowish-green appearance which is often noted in this bowel after death, as well as by its peculiar shape. By passing the finger around it, the bowel may now be brought well forward—Plate

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* Velpeau, Méd. Opératoire, tome iv.

XLVI. Fig. 3—into the opening, and a ligature being passed through the mesocolon so as to prevent its escape, a puncture may be made into the gut, and then this opening enlarged by an incision parallel with that in the integuments. The contents of the bowel being now evacuated, the mesocolic thread should be securely fastened to the parietes of the abdomen, and the intestine thus left until the third or fourth day, when, adhesions having formed between the surface of the colon and the front of the peritoneum, it only remains to prevent the tendency of the wound to contract and close the opening, by the use of a tent.

The subsequent dressing should be such as will protect the skin from excoriation, and guard against the tendency to eversion of the mucous coat of the intestine, as well as against the constant escape of the fecal matter. It may be usually accomplished by a compress and bandage, or by a truss, if the parts can tolerate it.

§ 2.—Formation of an Artificial Anus in the Lumbar Region.

The descending colon, passing from the left hypochondriac region to the left sacro-iliac symphysis, is covered by the muscles of the loins behind, and by the peritoneum in front, the attachment of the latter to the muscles immediately around the crest of the ileum being by a loosely-developed cellular substance. "In its general course, this bowel corresponds to the groove between the quadratus lumborum and transversalis muscles, and as this is near to the external border of the common mass of the sacro-lumbalis and longissimus dorsi, it may be easily recognized in moderately fat subjects. Sometimes the colon is more internal, and, in great part, concealed by the quadratus lumborum,"* Plate XLVI. Fig. 2.

The layers to be divided in the formation of an artificial anus in the loins, are the skin and subcutaneous fat, the latissimus dorsi muscle behind, the external oblique muscle of the abdomen in front, then the internal oblique and transversalis muscles, then the fascia transversalis, then fat, and lastly the intestine itself; the left colon being devoid of peritoneum in the posterior third of its circumference, especially when distended.

Operation of Amussat.—This operation is a valuable modification of that proposed by Callisen, and is performed as follows: The patient being laid on his belly, and slightly inclined to the right side, a transverse incision should be made in the skin, two fingers' breadth above the crest of the ileum, commencing at the external border of the mass common to the sacro-lumbalis and longissimus dorsi, and following it outward to the extent of four or five fingers' breadth. After incising the skin and subcutaneous tissue divide the latissimus dorsi transversely in the posterior third of the incision, the external oblique in the anterior two-thirds, and then the internal oblique and transversalis muscles and fascia, cutting them transversely and then vertically, so as to obtain a crucial incision. On reaching the adipose tissue which envelops the colon, raise it cautiously and search carefully for the intestine, which may be told by percussion, or by its color, or by feeling the resistance caused by its contents.

After certainly recognizing it, traverse the exposed portion with two needles, so that the bowel may be stitched with two loops of thread about an inch apart, and pierce it in the interval of the loops and divide the intestinal parietes crucially, so as to secure a free evacuation of its contents, aiding this, if necessary, by injections of warm water. Then drawing the intestinal opening well forward by means of three torsion forceps, fasten it to the skin by four points of the interrupted suture, Plate XLVI. Fig. 4.

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* Malgaigne.

Remarks.—The formation of an artificial anus for the purpose of giving vent to the fecal contents of the bowels, when prevented from escaping by the natural orifice, is an operation which has been practiced in adults in consequence of cancerous or other permanent obstructions of the rectum, and in children from malformation of the natural opening of the rectum. At first sight it would appear that this operation must evidently expose the patient to loss of life, and can, at best, prolong it only at the expense of a most loathsome condition. That the bowels may be thus opened, is certainly an evidence of the efforts of the surgeon toward relieving the defects of nature; but the results are by no means positive that the operation can secure to the patient even a continuance of a miserable existence.

§ 3.—Statistics of the Operation.

In the United States, the formation of an artificial anus has been attempted, but, as far as I can learn, without much success. In a case operated on by Warren, Senr., the patient died. In one operated on by J. M. Bush, of Kentucky, the patient also died on the fourteenth day; and of eight cases reported by Velpeau, six died and two recovered. But the results furnished by Hawkins, of England, as obtained from an analysis of 44 cases, shows that this operation is not quite so hopeless as might have been supposed. Thus, of 44 cases which he refers to, 22 were counted as recoveries; of these, 1 lived 17 years; 9 about a year; 5 died in 6 months subsequently, and 8 were either alive or lost sight of at the end of 12 months: 21 patients were from 40 to 60 years old, of whom 11 died; and 12 were from 20 to 40 years of age, of whom 6 died. Age does not, therefore, exercise any special influence on the operation.

But even with these results, it may be doubted whether it is advisable to induce an adult to submit to this operation, and whether, if left to nature, the chances of life might not be quite as great as those resulting from the operation. The inflammation, extending from the distended bowel to the surrounding parts, might obviate the chances of a general peritonitis, and, if the patient's strength could sustain the sloughing consequent on a rupture of the intestine, nature would doubtless make for herself an external vent. In such hopeless circumstances, the judgment of each one at the moment can alone decide upon the value of an operation. As regards the special advantages of an operation, as practiced in the groin, or in the lumbar region, Hawkins concludes that the decision may be left to the judgment of the surgeon, provided he operates on the left side of the body.

CHAPTER IX.

LIGATION OF THE ILIAC ARTERIES.

THE application of a ligature to the **Iliac Arteries** has been successfully performed at various points, from the origin of the common iliac along the main trunks of both its internal and external branches.

SECTION I.

SURGICAL ANATOMY.

The **Primitive Iliac Arteries** arise about the lower part of the fourth or fifth lumbar vertebra, and extend to within an inch of the sacro-iliac symphysis, where they divide into the Internal and External Iliacs. In this course, each Primitive Iliac Artery is bounded on the outer side by the psoas magnus muscle, behind by the primitive iliac vein, and, when of full length, is crossed at its lower part by the ureter. The right artery crosses in front of the root of the left iliac vein, Plate XLVII. Fig. 1.

The **Internal Iliac Artery** extends from its origin near the front upper part of the sacro-iliac symphysis to the lower part of the same articulation, being bounded behind by the sacral plexus of nerves, and being about one inch in length before it gives off any branches.

The **External Iliac Artery** extends from the bifurcation of the primitive iliac to Poupart's ligament along the internal margin of the psoas magnus muscle. In the commencement of its course it is anterior to the external iliac vein, but gets to its outer margin as it approaches Poupart's ligament. At this point it is about half way between the anterior superior spinous process of the ileum and the symphysis pubis, having the vein on its inside, and the anterior crural nerve half an inch from its outer margin, Plate XLVII. Fig. 1.

These arteries are behind the Peritoneum, the attachment of which to surrounding parts is generally by loose connective tissue.

SECTION II.

OPERATIONS UPON THE ILIAC ARTERIES.

The interruption to the circulation of the blood through these arteries, by means of compression, has occasionally been resorted to, and, in some instances, with partial success, the great objection to its employment arising from the proximity of the iliac veins, causing also an interruption in the venous circulation, with all the dangers and inconveniences which usually supervene on such obstructions. The ligature must, therefore, be regarded the best mode of treating the disorders of these blood-vessels, though this operation especialy demands operative skill, while compression requires rather good surgical judgment than manual dexterity.

§ 1.—Ligation of the External Iliac Artery.

The ligation of the **External Iliac Artery** was first performed by Abernethy unsuccessfully in 1796, and again successfully in 1806. His operation was performed as follows:—

Operation of Abernethy.—The patient being laid on his back, and a little inclined toward the sound side, so as to relax the abdominal muscles and throw the intestines from the incised side, an incision should be made about four inches long in the adult, commencing an inch and a half from and on the inner side of the anterior superior spinous process of the ilium, and extending obliquely toward the outer column of the external abdominal ring. After incising the skin and superficial fascia, tie any of the small arterial branches that may require the ligature, open the tendon of the external oblique, and introducing a director, divide the tendon in the course of the external incision. Then, carrying the forefinger beneath the fibres of the internal oblique and transversalis muscles, divide them with a probe-pointed bistoury, and, commencing at the iliac margin of the wound, press the peritoneum toward the median line of the body so as to overcome its cellular attachments to the iliac fascia. After exposing the artery about two inches above Poupart's ligament, pass the aneurismal needle under it, from within outward, or from between the vein and artery toward the ileum, Plate XLVII. Fig. 3.

Operation of Dorsey, of Philadelphia.—This operation, which was the first of its kind in the United States, was performed in 1811, as follows: An incision three inches and a half long was made, beginning an inch and a half above the anterior superior spinous process and one inch within it, and also four inches and a half distant from the umbilicus, so as to extend obliquely downward, and terminate about one inch above the aneurismal tumor, which was situated immediately below Poupart's ligament. After dividing the skin, superficial fascia, and external oblique tendon, the internal oblique muscle protruded at the wound, and, together with the inferior edge of the transversalis, was divided nearly up to the highest point of the wound. The cellular adhesions of the peritoneum being then overcome by the forefinger, the artery was readily felt pulsating, and was then separated gently from the adjoining parts without denuding much of it, when the vessel was secured by Physick's needle and forceps, Plate XLVII. Fig. 3.

Three knots being made upon the ligature, the ends were left at the external wound; and a strip of adhesive plaster, a pledget of lint, and a compress completed the dressing. The patient was then put to bed with the thigh moderately flexed on the pelvis, and the limb covered with carded wool and flannel. On the thirteenth day the ligature separated, and on the twentieth he was able to rise in his bed.

Operation of Wright Post, of New York.—A laborer, aged forty-one years, entered the New York Hospital, October, 1813, with an inguinal aneurism of the left side. After general treatment, the operation was performed, January, 1814, (it being the second of its kind in the United States,) as follows: An incision being made through the integuments with some degree of obliquity, beginning a short distance above the tumor, and extending upward externally to a middle line between the umbilicus and superior anterior spinous process of the ilium, so as to give it a length of between three and four inches, the abdominal muscles were cut through, until the peritoneum, at the lower part of the wound, was fully exposed. An endeavor was then made to detach this membrane from the crural arch, so as to get at the artery without opening the cavity of the peritoneum, but failed, as the strength and thickness of the membrane, at this point, were much greater than usual, and its adhesion to Poupart's ligament was so firm that the separation, which is usually so easy, was found in this case to be impracticable, in consequence of the pressure caused by the tumor. It was, therefore, necessary to cut through the peritoneum in order to arrive at the artery, which was done on account of the difficulties before referred to. The omentum protruded was easily replaced, and the artery felt; but every effort to detach the peritoneum from the sheath of the artery, by means of the finger nail, failed, and it only remained to pass a ligature under the artery by pushing the needle through the coverings of the vessel. To effect this, the point of the finger was placed on the inside of the artery, and a needle being conveyed along this as a director, it was made to pierce the coverings of the vessel, pass under the artery, and come out on the outside of it, by employing the forceps of Physick. After tying the ligature with care, so as to avoid including any portion of the intestine, the wound was closed with adhesive strips, lightly dressed, and the patient put to bed, the limb being covered with cotton. Pulsation returned in the tumor, but the aneurism did not increase, the ligature upon the artery not having arrested the circulation in the tumor, but only lessened it, though the patient ultimately recovered the use of a limb which had before been of no service to him.

Operation of Mott, of New York.—The skin and superficial fascia being divided by a curvilinear incision, which, commencing just above the external abdominal ring, extends outward and parallel with Poupart's ligament to a point a little above the anterior superior spinous process of the ileum, the tendon of the external oblique muscle will be fully exposed; then, this tendon being cautiously divided to the extent of the external incision, separate it from the internal oblique muscle and turn up the flap, and, carefully detaching the edge of the internal oblique and transversalis muscles from Poupart's ligament, turn them up also, when the tubular portion of the fascia transversalis, which invests the cord, will be readily seen. Picking this process up in the forceps, rub it between the fingers and nick it transversely with the point of the knife; then, introducing the finger at the opening, pass it along the cord to the internal abdominal ring, when the pulsation of the artery will be felt behind and below this ring, the cord serving as a guide, and rendering it certain that the finger passes below the peritoneum, or between it and the artery, without any injury to either. When you dilate the wound with broad spatulæ, get a good view of the artery, and, separating it from the vein, which is below and on its inner side, to an extent only sufficient for the passage of the needle, pass the former around the artery from within outward, or so that its point will pass from and not to the vein, when the artery may be ligated about one inch above Poupart's ligament, care being taken not to include any nervous filaments in the ligature.

After-Treatment.—Close the edges of the wound by a suture and adhesive strips, leaving both ends of the ligature hanging out of the lower angle, but do not apply any bandage which can constrict the part; after which the patient should be placed in bed, with the thigh slightly flexed on a pillow, while cotton or some other good non-conductor of heat is placed all round the limb, from the toes to the groin, so as to cherish the heat and vitality of the part.

Operation of Cooper.—This surgeon began his incision near the anterior superior spinous process of the ileum, and continued it to a point a little above the inner edge of the external abdominal ring, giving it a semi-elliptical shape.

After dividing the tendon of the external oblique, he followed the course of the spermatic cord with his finger, entered the internal abdominal ring, and, depressing the peritoneum, isolated the artery as before.

Operation of Bogros.—By an incision two or three inches long, equidistant at each end from the pubis and spinous process of the ileum, and immediately over Poupart's ligament, the skin and superficial fascia were divided, a director passed beneath the tendon of the external oblique, the spermatic cord raised, and its adhesions separated, the finger following the course of the cord to the internal ring where the epigastric artery may be readily found on the inside of the ring. Tracing with the finger the course of this artery to its origin, it only remained to push aside the adhesions of the areolar tissue, and ligate the vessels.

Remarks.—By reference to the Bibliographical Index at the end of this part, it will be seen that the operation of ligating the external iliac artery has been frequently performed with success in the United States, the names of Whitridge, of Charleston, Nathan Smith, of New Hampshire, Jameson, of Baltimore, Stevens and Rodgers, of New York, Warren, of Boston, and Barton and Randolph, of Philadelphia, being associated with the earlier operations, while those of many others are connected with the subsequent operations on this vessel.

§ 2.—Statistics of the Application of a Ligature to the External Iliac Artery.

The results of the operation of ligating the iliac arteries have varied somewhat according to the branch tied, though the external iliac, from being the most superficial as well as that most directly connected with the femoral and popliteal arteries, has been more frequently ligated than either or both of the others. As the circulation can be readily carried on by other vessels when this branch of the iliac is tied, the subsequent difficulties have been less, and the success attendant on the operation such as establishes the propriety and advantage of ligating this vessel for aneurism, or wound of the femoral artery.

The following cases have been collected from the works of the surgeons whose names are mentioned:—

Ligation of the External Iliac Artery.

	Cases.	Cured.	Died.
Abernethy[*]	4	2	2
Freer[†]	3	3	0
John C. Warren[‡]	4	3	1
Mott[§]	7	4	3
Other American surgeons	22	17	5
	40	29	11

From this summary, it appears that of forty cases operated on, twenty-nine have been cured and eleven died, or more than two-thirds of the cases operated on have been cured.

Of one hundred and eighteen cases reported by Norris, eighty-three were cured and thirty-three died, three who recovered undergoing amputation, which also shows that more than two-thirds were cured.

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[*] Observations on Aneurisms, by J. Abernethy.

[†] Ibid., by George Freer.

[‡] MS.

[§] Transactions Am. Med. Assoc., vol. iv. p. 269.

PLATE XLVII.

VIEW OF THE PARTS CONCERNED IN THE OPERATION OF LIGATING THE ILIAC ARTERIES.

Fig. 1. Surgical anatomy of these Arteries. 1. Aorta. 2. Right primitive iliac. 3. Right external iliac. 4. Left primitive iliac vein. 5. Ascending vena cava. 6. Spermatic vessels. 7. Ureter crossing the iliac artery. 8. Internal iliac artery. 9. Lymphatics and glands. 10. Anterior crural nerves. 11. Section of the abdominal muscles. 12. Anterior superior spinous process. 13. Fascia lata. 14. Psoas muscle. 15. Iliacus internus. 16. Circumflex iliac artery. 17. Epigastric vessels. 18. Sheath of the femoral vessels. 19. Saphena vein. 20. Lymphatic vessels of the thigh. 21. Spermatic cord. 22. Bladder. *After Bernard and Huette.*

Fig. 2. Appearance and position of an Aneurismal Tumor of the Femoral Artery, showing the effect upon the superficial vessels, etc. Ligation of the external iliac was required. *After Auvert.*

Fig. 3. Ligation of the External Iliac Artery. 1. The artery distended, and with the needle beneath it. 2. Incision of the skin. 3, 4. The divided edges of the muscles and fascia of abdomen. 5. The peritoneum everted. 6. The external iliac vein. *After Bernard and Huette.*

Fig. 4. Operation of ligating the Primitive Iliac Artery, as shown upon the subject. The artery has been raised a little by a ligature toward the orifice of the wound, in order to show it more distinctly. *After Nature.*

Fig. 5. Ligation of the Internal Iliac Artery, as shown upon the subject, the arteries being filled with wax. *After Nature.*

Fig. 6. A view of the condition of the Blood-vessels, as found after death in the patient upon whom Peace tied the right Primitive Iliac Artery, showing by what means the circulation was carried on. 1. Aorta. 2. Primitive iliac, that on the right side, as well as the right external and internal iliacs, being obliterated. 3. Middle sacral much enlarged. 4. Aneurismal sac. 5. Epigastric artery much enlarged. 6. Enlarged ilio-lumbar artery. 7. Circumflex iliac. 8. Obturator artery. 9, 9. Lumbar arteries much enlarged. *After Nature.*

Fig. 7. A view of the left Iliac Vessels of the same patient. 1. Aorta. 2, 2. Primitive iliacs. 3. Middle sacral, as seen in the previous drawing. 4. Left internal iliac, with all its branches much increased and anastomosing freely with right side. 5. Left external iliac. 6. Left epigastric displaced in the preparation. 7. Poupart's ligament. 8. Left femoral artery. *After Nature.*

Plate 47.

Fig. 1.

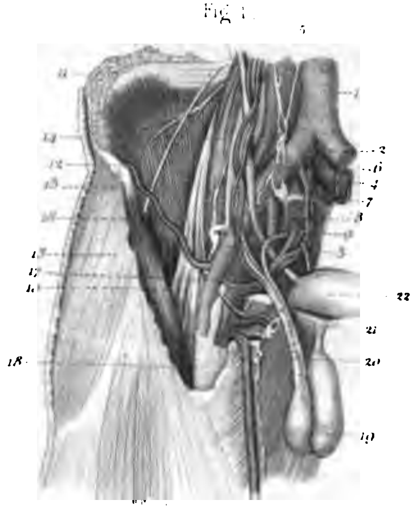


Fig. 2.

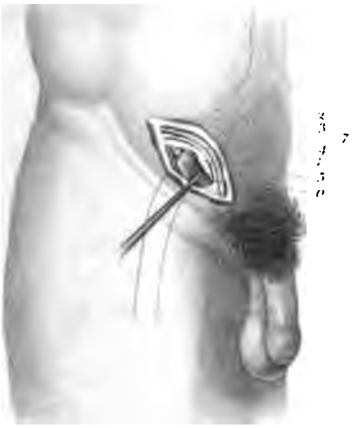
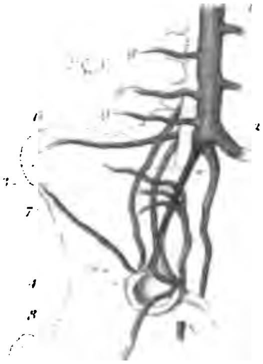
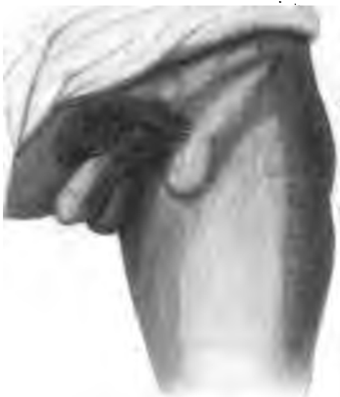


Fig. 2





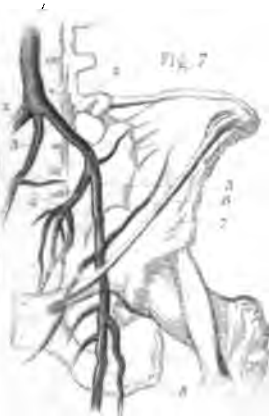
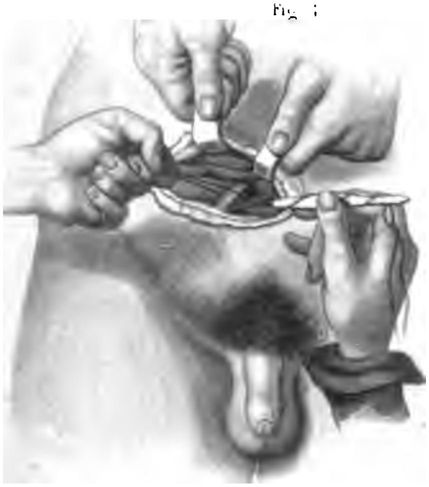
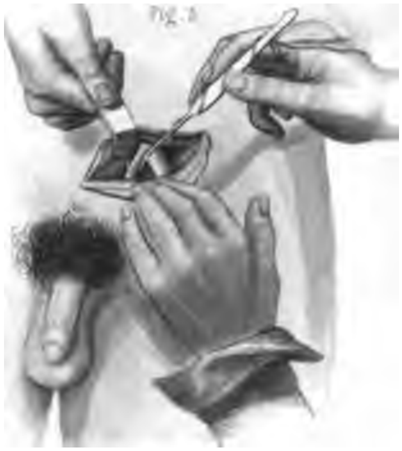


Fig. 4





SECTION III.

LIGATION OF THE PRIMITIVE ILIAC ARTERY.

The **Ligation of the Primitive Iliac Artery** is one which dates back only to the year 1812, when it was first performed for the arrest of traumatic hemorrhage, by Gibson, of Philadelphia, (then residing in Baltimore,) but without success. The first successful ligation of this artery for aneurism was accomplished by Mott, of New York, in 1827.

§ 1.—Surgical Anatomy.

The **Primitive Iliac Arteries**, being the terminating branches of the abdominal aorta, are about an inch long where they divide into the external and internal iliacs. Most commonly, each primitive illiac arises about the fourth lumbar vertebra, though sometimes it comes off as low as the inferior edge of the fifth. These arteries rest upon the parts about the alæ of the sacrum, or side of the sacro-vertebral angle, having the psoas magnus muscle upon the outer side, and being crossed at their lowest portion by the ureter. On the right side, the primitive iliac vein is outside, and then behind the artery, but on the left, the vein lies upon the inside of the vessel, though it does not reach this point until it has passed under the root of the right iliac artery. The peritoneum covers the vessels, and they are easily approached simply by overcoming with the finger the loose attachments of this membrane to the part.

§ 2.—Operation of Ligating the Primitive Iliac Artery.

The approach to the Primitive Iliac Artery may be accomplished by a slight extension of such incisions as have been recommended for the ligation of the external iliac. In the operation of Mott, in 1827, which was the first successful operation ever performed, as well as the first done for the relief of aneurism, the following plan was pursued :—

Operation of Mott.—The aneurismal tumor, though of only ten days' standing, occupied the whole extent of the external iliac, extending from within Poupart's ligament to some distance above the origin of the internal iliac artery, was of large size, and protruded the belly considerably at the iliac region.

By an incision parallel with and about half an inch above Poupart's ligament, and extending from the external abdominal ring to one or two inches above the crest of the ilium, the skin and muscles were cautiously divided, and turned up as in the operation upon the external iliac artery, when the peritoneum was cautiously detached with the fingers, as in the preceding operation, without being injured. The artery being then examined, the aneurismal dilatation was found to cease at about half the distance between the bifurcation of the aorta and the origin of the internal iliac branches. The ligature was, therefore, passed around the vessel from the outside—so as to avoid the iliac vein—by means of Parrish's needle, great care being taken not to injure the ureter, or the iliac vein, Plate XXXV. Fig. 2, whenafter tying the knot, the wound was held open in order to satisfy those present of the exact situation of the ligature, which was seen to be just below the bifurcation of the aorta, and on the side of the sacro-vertebral promontory.

The wound being lightly dressed, the patient was put to bed, and the means previously mentioned employed to preserve the heat of the limb until the circulation was restored, the patient being ultimately cured.

In the case operated on by Gibson, in 1812, the artery was tied by means of a ligature passed around it by an ordinary eyed probe, the original wound being enlarged to the extent of seven inches. This patient died, on the fifteenth day, of hemorrhage, and, on dissection, it was proved that two ligatures had been placed on the common iliac artery of the left side, about half an inch below the bifurcation of the aorta. The upper ligature was found detached, but no union had occurred in the vessel.*

Operation of Peace, of Philadelphia.†—A man, aged thirty-six years, was admitted into the Pennsylvania Hospital, in August, 1842, with an inguinal aneurism of the right side, created by a strain in lifting stone, to relieve which it was decided to ligate the common iliac artery.

Operation.—An incision seven inches long was made through the integuments, commencing at a point on a level with the umbilicus, two inches within and three inches above the anterior superior spinous process of the ilium, approaching to within an inch of Poupart's ligament, and terminating one-half inch above the external ring. This divided the arteria ad cutem abdominis, which was twisted by the artery forceps. The superficial fascia being next divided, the tendon of the external oblique was nicked and incised upon a director the whole length of the first incision as far inward as the spermatic cord. Considerable difficulty was now experienced in raising the lower edge of the tendon of the internal oblique and transversalis, owing to the induration of tissue from the pressure of the tumor, but this was finally accomplished by means of the knife-handle, and, the parts being then carefully divided, the peritoneum was reached. When this was cautiously detached from the tumor, the latter was found to involve a large portion of the external iliac artery, but by raising the peritoneum a sound part of the artery was noticed, about half an inch above the bifurcation of the common iliac.

The artery being now separated from the vein by the finger nail, a silk ligature was passed around it by Gibson's needle, Plate XXXV. Fig. 12; but notwithstanding the precautions taken to evacuate the bowels, and the length of the incision, it was difficult to see the point of the needle under the artery, on account of the protrusion of the bowels and the projection of the tumor. Finally, by means of broad, curved spatulæ—Plate XLVII. Fig. 4—the parts were seen, and the ligature being tied with a double knot, both ends were allowed to hang out of the wound, which was then closed by adhesive strips, three points of the interrupted suture, lint, etc. The patient was then placed in bed, with his shoulders slightly raised, his body flexed and inclined to the affected side, and the limb flexed upon a pillow under the knee. In fifteen days the ligature came away, and the patient recovered perfectly.

This patient dying subsequently, Peace succeeded, after much trouble, in injecting the blood-vessels, and in making a dissection of the part. Although, from the opposition of the patient's friends, the preparation was imperfectly made, it yet shows the means by which the circulation was carried on. From this preparation I have been enabled, through the politeness of the operator, to have the two sketches made as represented in Plate XLVII. Figs. 6, 7, and from inspection of the collateral branches of the artery as seen after the operation, as well as from the minuteness with which the operation has been detailed by the operator, much valuable information may be gained by those who may hereafter desire to repeat it.

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* Med. Recorder, vol. iii. p. 185.

† Am. Journ. Med. Sciences, vol. v. N. S. p. 269. 1843.

Remarks.—A knowledge of the great amount of the circulation which would be cut off from the lower extremity, by the application of a ligature to this vessel, at first led surgeons to believe that it would be impossible to preserve the vitality of the limb after this operation. The credit of demonstrating the contrary is, therefore, due to the surgeons of the United States, who, in the cases operated on, conclusively showed that nature was able to remedy even this serious obliteration of the natural channel of the blood to the lower extremities.

§ 3.—Statistics of Ligation of Primitive Iliac.

Since the primary operation upon the **Primitive Iliac Artery,** thirteen others have been reported, as follows: Crampton, in 1828; Liston, in 1829; Guthrie, in 1833; and Syme, 1838, in England; by Salomon, of St. Petersburg, in 1837; Deguise, of Paris, in 1840; by Bushe, of New York, in 1832; Post, of New York, in 1840; and Pirogoff, of Russia; by Peace, of Philadelphia, in 1842; by Hey, of England, in 1843; by Stanly, of London, in 1846; two by Garviso, of South America; and one recently by Wedderburn, of New Orleans.*

Of the seventeen cases before specified, eight were cured and nine died; showing, as it is thought, the justifiable character of the operation under circumstances similar to those which have before required it.

§ 4.—Ligation of the Internal Iliac Artery.

The **Ligation of the Internal Iliac Artery** has been occasionally performed for the relief of aneurismal tumors in its gluteal or ischiatic branches. As there is an ample supply of vessels through which the circulation may be conducted, the application of a ligature to this artery would not, in all probability, be attended by serious consequences, were it not from the risk of peritonitis necessarily created by the operation.

The plans proposed for the application of the ligature have varied considerably from those suggested in connection with the external iliac, chiefly because the latter vessel has been most frequently tied in its lower part. As the external and internal arteries come off at the same point, it is evident that a slight prolongation of the ordinary operation upon the external branch of the artery would enable the operator also to tie the internal. But as the plans employed have differed materially from those pursued in ligating the former vessel, the ligation of this vessel has, therefore, taken the position of a distinct operation. The operation was first performed by Stevens, of Santa Cruz, then by Atkinson, of England, and then by White, of New York, as hereafter shown.

Operation of Stevens, of Santa Cruz.—In the case of a negress who labored under an aneurismal tumor of the left buttock, of the size of a child's head, Stevens proceeded as follows:—

Operation.—By an incision, five inches in length, made in the course but a little to the outer side of the epigastric artery, the abdominal parietes were divided, the attachment of the peritoneum, from the spine of the ilium to the left sacro-iliac symphysis, overcome by pressing upon it with the finger, and the origin of the artery being felt by the forefinger, the internal iliac was tied by passing a ligature around it, about half an inch below its origin. This patient was cured in three weeks; and, ten years afterward, when she died, the preparation was sent to London, but the aneurism was found to have been in the ischiatic instead of the gluteal artery, as had been supposed.

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* Norris, Am. Journ. Med. Sci., vol. xiii. N. S. p. 24. 1847.

Operation of S. Pomeroy White, of New York.—It being decided to tie the internal iliac artery in order to relieve a gluteal or ischiatic aneurism, White operated as follows, without any knowledge of the operation of Atkinson, although aware that Stevens had previously succeeded in his operation:—

Accordingly, he made a semicircular incision, seven inches long, and with its convexity toward the ileum, commencing two inches to the left of the umbilicus and ending at the external ring, so as to divide the skin, areolar tissue, and fascia superficialis. Then, the tendon of the external oblique muscle being exposed, it was carfully divided, as were also the external oblique and transversalis muscles, as well as the transversalis fascia. The peritoneum being now detached by the fingers from the iliacus internus and psoas magnus muscles, it was pressed with its contents toward the right hypochondriac region, when the external iliac artery being felt and traced by the finger toward the sacro-iliac symphysis, the internal iliac was distinctly recognized, and, being exposed with the handle of a scalpel, was ligated by carrying the thread around it with Parrish's needle, the knot being firmly tied by Hosack's knot-tier, and the wound subsequently closed with sutures and adhesive strips. The patient soon afterward recovered.

Remarks.—This operation was among the earliest of those practiced upon this artery, and was certainly indicative of remarkable coolness and skill on the part of one who was at that time a young surgeon. Considerable difficulty was experienced by him in consequence of the constant protrusion of the peritoneum, from the abdominal compression caused by the struggles of the patient. The modern discovery of anæsthetics has, however, obviated this, and the ligation of this vessel, like many other operations upon the abdomen, may now be performed without any such annoyances, as the patient will remain perfectly tranquil, and the bowels have little or no tendency to protrude when the anæsthesia is complete.

Operation of H. J. Bigelow, of Boston.—A middle-aged woman being stabbed by her husband in the right buttock, the injury led to the formation of an aneurism of the gluteal artery, to relieve which the internal iliac was tied as follows:—

By an incision above but parallel with Poupart's ligament, Plate XLVII. Fig. 5, the skin, muscles, and fascia were divided, the peritoneum separated from its attachments to the iliac fossa, and the artery readily attained and tied, instantly relieving the aneurismal symptoms; but the patient died of peritonitis on the eighth day. The autopsy exhibited the ligature as placed around the internal iliac, just above its branches, with a satisfactory clot extending from this point to the bifurcation at the common iliac artery.

Operation of Hilman Kimball, of Lowell.—A patient, with a pulsating tumor on the back of the thigh, so high up as to cause inconvenience when sitting, having exhibited all the symptoms of gluteal aneurism, the internal iliac artery was tied in the following manner: The patient being placed in a convenient position in bed, and rendered insensible by chloroform, an incision six inches long was made immediately above and nearly parallel with Poupart's ligament, beginning at a point just external to the spermatic cord as it passes through the external ring, and running outward for three inches, and then turning more upward, so as to terminate at a line about midway between the anterior superior spinous process of the ileum and the umbilicus. The abdominal muscles and fascia being then carefully divided, and the peritoneum pushed off from its inferior attachments, the external iliac artery was brought into view, when the peritoneum was still further raised from its pelvic connections by running the forefinger along the inner edge of the psoas muscle, till it reached the promontory of the sacrum. The internal iliac artery being now readily traced in its descent from its origin, the forefinger was kept upon it while the ligature was carried around it by means of Scarpa's needle, and the vessel tied, by an assistant, about an inch from its origin. No accident or embarrassment occurring during the operation, and no vessel being cut that required the ligature, the wound was closed by two or three sutures and adhesive straps, and covered with lint kept wet with water, as in the water-dressing. Secondary hemorrhage supervening on the fourteenth day, the patient died on the sixteenth. At the autopsy, the portion of the artery between the ligature and the bifurcation being slit open, was found entirely empty and without signs of inflammation on its inner surface, or of a coagulum, while the part immediately around the seat of the ligature had begun to give way, disclosing a very small aperture, but one sufficiently large to account for the fatal hemorrhage. As there were no efforts at the formation of coagulum above the ligature, the question was raised, whether these results were not connected with the large amount of chloroform inhaled during the operation.

Remarks.—The internal iliac artery was first tied successfully in the United States by S. Pomeroy White, then of Hudson, but now of New York; and subsequently by Mott, also successfully, although the peritoneum was opened during the operation; the operations of Bigelow and Kimball, of Massachusetts, were unsuccessful. The great dangers of the operation are to be found in the tendency to peritonitis, and in the injury to the vein in the immediate neighborhood of the artery.

Statistics.—Of ten cases of ligation of this artery as reported by Norris, in his table on the ligation of the iliacs, and also referred to in the Bibliographical Index of this part, to wit, one by Stevens, of Santa Cruz; one by Atkinson, of England; one each by S. Pomeroy White, Mott, and J. K. Rodgers, of New York; one each by Thomas, White, and Arendt, of England; and one each by Bigelow and Kimball, of Massachusetts, four were cured and six died, all the operations being performed for aneurism.

CHAPTER X.

OPERATIONS PRACTICED ON THE BACK.

THE posterior surface of the trunk presents no points of structure which require more than a passing allusion, the great number and mass of the muscles, together with the arrangement of the vertebræ, being matters of general anatomical knowledge. The operations, also, which are performed upon this region do not demand any special caution, unless it may be in the complaints due to the disorders of the spinal canal. In order, however, to preserve the unity of description which has been desired in the arrangement of this work, some of the more important cases requiring operative aid will be detailed, as illustrating the operations required in the complaints of this region.

SECTION I.

SUPERFICIAL TUMORS OF THE BACK.

The integuments and muscles of the back are liable to very much the same class of tumors as are found in similar tissues elsewhere, and require for their removal precisely the same means, to wit, such an incision of the skin and subsequent dissection as will create as little disturbance as possible of surrounding parts. As illustrative of the operation demanded by the wens of this region, the following case is cited:—

Removal of a large Steatomatous Tumor, by Dorsey, of Philadelphia.—The patient, a negress, aged about forty-five years, was admitted into the Pennsylvania Hospital, in 1815, with a tumor upon the back, the dimensions of which were as follows:—

Circumference at the narrowest point, 2 feet 10 inches.
" " thickest part, 3 " 9 "
" " horizontally, 3 " 1½ "

The weight of the tumor, after removal, was twenty-five pounds, Plate XLVIII. Fig. 3.

Operation.—After administering an opiate, the patient was placed upon her face on the table for fifteen minutes, while assistants elevated the tumor so as to empty it as completely as possible of blood. Then external incisions, calculated to preserve sufficient skin to cover the surface, being made, the skin was dissected off from the tumor and turned back, and the tumor freed from its attachments by large and rapid incisions, although it adhered somewhat to the spinous processes of the vertebræ, and to the muscles and tendons near the spine. After cleansing the parts thoroughly, the skin was closed by adhesive straps and a bandage, and the wound healed to a considerable extent by the first intention.

Remarks.—Steatomatous, encysted, and hygromatous tumors are also sometimes found upon the back of the neck, as well as upon the shoulders, and may be treated by very much the same method. Some caution, however, is requisite in forming a diagnosis in these cases, lest they be confounded with **Spina Bifida,** the development of which is occasionally seen in the median line of this region, while the tumors before referred to are most frequently seen on either side.

In Plate XLVIII. Fig. 2 may be seen an example of one of these tumors —**Hygroma**—which caused doubts in the mind of Auvert as to its true character.

In wounds and fractures of the vertebral column, the surgeon may also find it necessary to deliberate upon the propriety of such mechanical interference as may afford the hope of relief, though generally the chances of success will be quite as good when the case is left to nature as when any attempt at an operation is made by the surgeon. In cases of depressed fracture of the spinous processes, the soft tissues have been incised, and an attempt made to draw out the fractured portion; but there is so little reason to anticipate any permanent benefit from such operations, that it must suffice merely to mention the fact of their having been performed. Wounds of the spinal marrow, by the introduction of foreign bodies, have also done well when left to nature, an instance in which a chisel divided the spinal marrow, and yet the patient recovered, having been reported by Eli Hurd, of Niagara County, New York.

SECTION II.

TUMORS OF THE SPINAL CANAL, OR SPINA BIFIDA.

Spina Bifida, or **Hydrorachis**—*ὕδωρ*, water, and *ραχις*, the spine—is a disease characterized by the presence of a soft, fluctuating, and often transparent tumor, formed in consequence of the membranes of the spinal marrow being distended by liquid, and caused to protrude beneath the integuments or directly upon the back, Plate XLVIII. Fig. 4, owing to a congenital deficiency of some of the spinous processes of the vertebræ, whence the name of spina bifida, or bifid spine. From the observations of Chaussier, it appears that of one hundred and thirty-two children born during a period of five years, twenty-two suffered from spina bifida; and Billard has seen this complaint seven times in one year among the children in the Foundling Hospital of Paris.

Symptoms.—Soon after birth there is noticed at some point of the spinal column, and most frequently in the lumbar region, a tumor of variable size, which is then diaphanous, and evidently filled with liquid; usually the tumor is uncovered by the integuments of the part, or if they cover it, they are sometimes extremely attenuated. If gentle pressure is made on the tumor, its contents will pass into the spinal canal, and the tumor will more or less thoroughly disappear; but the attempt should be cautiously made, lest paralysis or death supervene from the pressure of the liquid thus forced into the spinal canal. Spina bifida is often combined with hydrocephalus.

Diagnosis.—The size and translucency of the tumor, with its position and the age and history of the patient, render the diagnosis usually easy. If doubt exists, the exploring needle carefully introduced will give exit to a drop of serum.

Prognosis.—The prognosis should be guarded; cures have occasionally been obtained, but failures are very common. The disorder, when left to nature, is usually fatal after a time.

Treatment.—Various plans of treatment have been resorted to, among the most successful of which may be mentioned pressure and acupuncturation.

§ 1.—Operations for the Cure of Spina Bifida.

The various methods of treating this complaint, as practiced in Europe, seemed to have gained but a very limited success; and the following results obtained by surgeons in the United States are, therefore, more deserving of attention, especially as they have occurred under circumstances where there could be no doubt in regard to the nature of the changes induced by the disease, or in the correctness of the diagnosis.

Operations of Trowbridge, of New York, in 1829.—A child, aged twenty-one months, was presented for advice in June, 1827, laboring under spina bifida. The tumor was seated over the lower cervical vertebræ; was as large as an egg; entirely covered with a cellular substance, and fluctuating.

Operation.—A small silver wire being placed in a loop around the base of the tumor, the ends were passed through a short canula and drawn moderately tight, so as to produce slight inflammation on the surface at the base. Forty-eight hours having elapsed without any bad symptoms, the wire was then drawn tight enough to destroy all circulation in the tumor; twelve hours after which, the child became restless and feverish. In forty-eight

PLATE XLVIII.

EXTERNAL CHARACTERS OF TUMORS OF THE NECK AND BACK.

Fig. 1. Congenital Tumor of the Veins about the Neck. This child was twelve months old; the tumor filled the whole neck; projected beyond the chin, and felt like a coil of vessels folded in every direction on each other, or like a bundle of round worms. *After Warren.*

Fig. 2. A view of the appearance and position of a Large Hygroma of the Back of the Neck. This tumor was noticed in a child some months after birth, and was supposed to be due to an injury of the part, caused by the application of the forceps. It was relieved by puncture. *After Auvert.*

Fig. 3. Appearance presented in Julia Richards, a negress, who had a large Sarcomatous Tumor upon the back, which was successfully removed by Dorsey, of Philadelphia, in 1815. The tumor had existed eighteen years, grown gradually, and never been painful, but its size compelled her to walk as if carrying a large and heavy sack upon her back. The surface of the tumor was tolerably regular, but very large and numerous veins were seen in various parts of it. The narrowest part of the tumor was thicker than the patient's waist, and its base was very extensive. After being emptied of blood, its weight was twenty-five pounds. The dimensions of the tumor are stated in the text. *After Dorsey.*

Fig. 4. A view of the position and external characters of Spina Bifida in the loins. This tumor was of very considerable size, the drawing representing it as only one-fourth of its natural size. It was seated in the lumbar region, nearly on a line with the crest of the ileum, and was accompanied by a deficiency in the spinous processes of several of the adjoining vertebræ. *After Froriep.*

Plate 48.

Fig. 1.

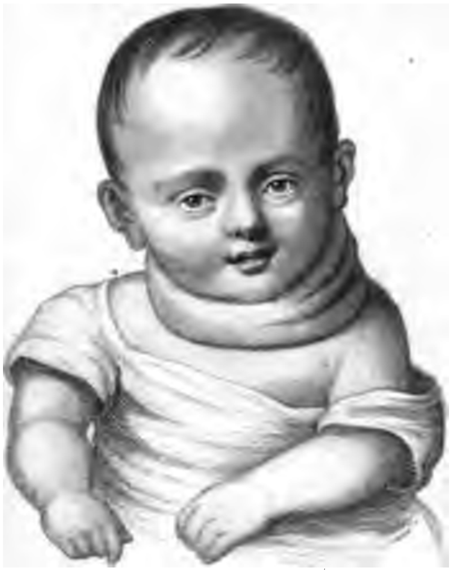


Fig. 2.

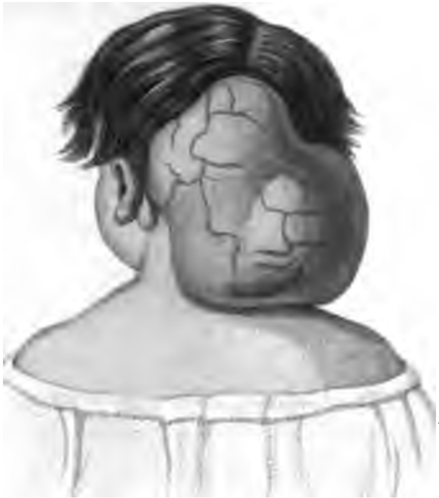
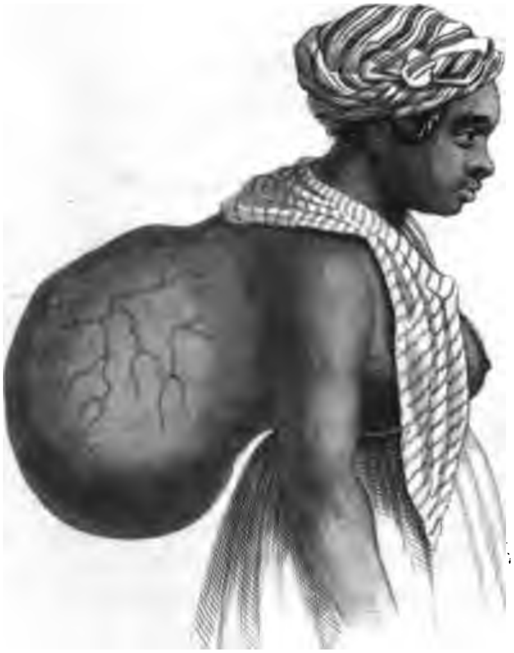


Fig. 3.



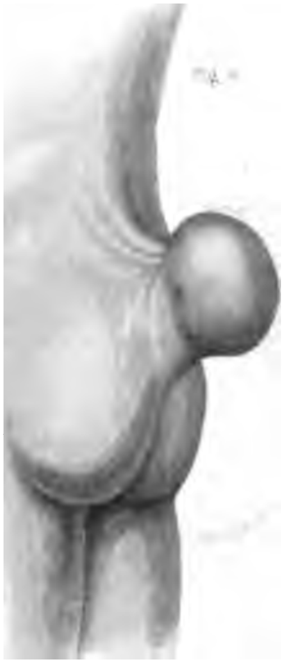


Fig. 4.

hours more, the tumor was dark colored ; suppuration had commenced around the wire, and the latter disappeared in the divided integuments, when, the tumor being excised above the loop, the wire came off, and left an inflamed portion three-quarters of an inch in diameter, with an aperture through which there was discharged turbid lymph or serum, with a slight arterial hemorrhage, which required the use of lint. A preternatural opening into the spinal canal being now discernible, situated between the two lower cervical vertebræ, the dressing of lint was left on for forty-eight hours, and then changed, as the fluid continued to discharge ; but in twelve days more the wound had healed, and the child was subsequently as healthy as other children.

In a second case, aged two years and six months, the tumor was situated over the three lower cervical vertebræ, was represented as having been very large at birth, and now measured seven inches in circumference at its outer portion, something less at its base, and was about four inches in height. It was covered with integuments and natural skin, and fluctuation was quite distinct.

Being operated on in the manner just detailed, the ligature was allowed to remain four days after its first application, and drawn tighter three days after this, the child suffering from symptoms of phlegmonous inflammation. Nine days after the application of the ligature, the sphacelated tumor was excised ; a wineglassful of turbid and bloody serum spouted out through the opening, and bleeding from an artery followed, which required the ligature. Under similar treatment to that first detailed, the fluid was discharged from the aperture for eight days, after which the opening gradually diminished, and in four weeks from the operation the whole wound had cicatrized. A spinous process was found wanting in the vertebral column, and there was an opening through the vertebræ which admitted the point of the little finger.

In a third case, aged four years and three months, the tumor, which was situated over the sacrum and three of the lower lumbar vertebræ, measured thirteen inches in circumference at the base, and seven in its projection from the back.

Operation.—Incisions being made through the integuments, which were about an inch thick, from the upper portion of the base quite to the lower part over the sacrum, sufficient flap was left to cover the wound in a manner similar to that pursued in excising the female breast. On dividing the integuments, a cavity was found which contained several cysts filled with fluid, and attached to the spinous processes of the third lumbar vertebra. The spinous processes above and below were wanting. There being no communication with the spinal canal, the cysts were dissected out, and the child recovered perfectly.

Remarks.—Trowbridge reports having seen about thirty cases of spina bifida in all points of the vertebral column, and has tried puncture, compression, ligature, incision, etc., and often failed, but "prefers the ligature, as above directed, in all cases where the base of the tumor admits of its application." By not tightening the ligature too much at first, only moderate inflammation is induced and the sympathetic disturbance is diminished.

Operation of Skinner, of North Carolina.—The patient, aged seventeen months, presented a tumor on the spine more than three and a half inches long, two and a half wide, and one and a half deep, extending from a level with the iliac crest to near the verge of the anus, the contents of which, by firm pressure, could be mostly compressed into the spinal canal. At first, a puncture with a very fine needle drew off a few drops of liquid; two days subsequently a larger needle drew off a drachm; at another period half an ounce, then an ounce, and then an ounce and a half, after which pressure was applied around the base of the tumor. After about seventy punctures had been made without any serious accident, and the tumor had become reduced to one-fourth of its original size, an indiscretion of diet induced diarrhœa, under which the patient sank.

Operation of Stevens, of New York.—A child, eight months old, presented a tumor nearly similar in position and size to that just described. Being punctured with an iris knife, about four ounces of clear serum issued from the opening, without causing inconvenience. Three days subsequently the operation was repeated, but not more than an ounce escaped. The next day it was again punctured in three places, and about four ounces escaped without bad symptoms, and continued to ooze for nearly twenty-four hours after the operation, the child showing some febrile symptoms, which were thought to be partly due to teething. Evaporating lotion was then kept applied to the tumor, and the sac was not again punctured. These febrile symptoms soon disappeared, and the child, when seen several months afterward, showed nothing of the disorder except a small lump of indurated and corrugated integument. In this case the fluid was always evacuated very slowly, that is, at the rate of about three drops in a second, about one-third being left in the sac, and slight pressure being made after each operation; and much of the success of the treatment is ascribed by Stevens to this mode of proceeding.

Operation of Brainard.—An idiotic girl, aged thirteen years, had a tumor at the top of the sacrum nine inches in circumference, and about three in height, with thin walls; had been paralytic in her lower limbs, but recovered a partial use of them a short time previous to the operation. All her discharges were passed without attention to cleanliness. Under these hopeless circumstances the operation was thus performed.

A small puncture being made with a lancet on the sound skin about half an inch from the base of the tumor, a trocar and canula the size of a common knitting-needle were carried into the sac. Through the canula a solution of iodide of potash gr. j, iodine gr. ss, and water ℥j, was thrown into the sac, and the instrument withdrawn. A severe pain followed, but soon subsided; compresses and a bandage were applied to prevent the escape of the fluid, and the child was laid in bed. Redness, heat, and tension of the tumor, with tenderness and some fever, supervened; but in the course of a week these symptoms subsided, and the tumor became soft, yielding, and diminished in size. Compression was then applied with as much force as could be borne. Fifteen days after the operation the tumor was half its original size, when a second injection, half the strength of the first, was thrown in, and caused but little heat and pain, compression being continued. Nineteen days subsequently the fluid was so far absorbed as to render it easy to press the tumor nearly to the level of the surrounding skin, when a spring truss was applied to the part, and under this the child improved.

Remarks.—The success attending the treatment of the cases just recited is certainly sufficient to justify the surgeon in resorting to similar means when proper circumstances demand it. The suggestion of an injection of iodine into the cavity of the tumor, as made by Velpeau, and practiced by Brainard, is due to the analogy supposed to exist between spina bifida and hydrocele, and the result it was hoped would authorize a repetition of this operation; but as this resemblance is not perfect, great care should be employed, lest death ensue from inflammation of the spinal canal. In a paper subsequently published by Brainard, he states that the number of injections used in this case was fifteen, and that the time required for the cure was ten months, the patient being in good health two years subsequently.

In encysted spina bifida, or that in which the communication between the sac and the cavity of the spinal canal is obliterated, this injection may again succeed, and prove to be an excellent plan of treatment. But in spina bifida complicated with hydrocephalus, or in that where the medullary canal is pervious, inflammation of the pia mater, or of the spinal marrow itself, should be anticipated, and then the propriety o exposing the patient to such a risk carefully considered. In the case of an infant a few days old, treated by Brainard, in 1849, by the same injection, death supervened in about seven weeks; and in another three months old, treated by him, in 1850, death followed in about four weeks. In another child, four days old, laboring under spina bifida and hydrocephalus, both the cavities of the spine and cranium were injected at different periods, and the injections repeated several times. In this case there was good reason to hope for success, as the child exhibited great tenacity of life, but in the seventh month of the treatment this child also died in convulsions. Brainard, however, regards spina bifida as a curable disease, by a similar treatment; although success, as he says, must not always be anticipated. A careful perusal of his paper compels me, however, to dissent from this opinion; and I regard the operations of Trowbridge, Skinner, and Stevens as safer and better adapted to the cure of most of the cases that may be presented for treatment.

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OPERATIONS ON THE ABDOMEN.

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Case of Gastrotomy, (successful,) by J. E. Manlove, M.D. Tennessee.—*Am. Journ. Med. Sciences*, vol. x. N. S. p. 532; also *Boston Medical and Surg. Journ.*, July, 1845.

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ON HERNIÆ.

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PART XV.

DISORDERS OF, AND OPERATIONS ON, THE GENITO-URINARY ORGANS AND RECTUM.

CHAPTER I.

DISORDERS OF THE MALE GENITO-URINARY ORGANS.

The Genito-Urinary Organs in man being intended for the performance of two distinct functions, to wit, the conveyance of sperm into the female, and the evacuation of the urine, occasionally demand the aid of the surgeon, either in order to remedy congenital defects, or to relieve the evils resulting from disease. Of the operations performed upon these organs, some are intended for the relief of deformities, and are limited solely to the body of the penis; while others, being intended to favor urination, are confined to the urethra. Some are limited to the testicles, and others to the removal of foreign bodies from the bladder. The latter having a special importance, will be referred to in a distinct chapter.

From the varied character of the structures concerned in these operations, it is apparent that anything like a detailed account of each part would necessarily lead into the domain of special anatomy; but as it may facilitate the reader's comprehension of the disorders as well as of the steps of the operations required for their relief, I shall present a brief account of the general relations of the parts to each other.

SECTION I.

SURGICAL ANATOMY OF THE MALE ORGANS.

The **Genito-Urinary Organs** of man consist of the testicles and vesiculæ seminales, and of the penis, urethra, and bladder, the penis being formed both for the function of procreation and urination.

§ 1.—The Penis.

The **Penis** is attached to the front of the bones of the pelvis, at and below the symphysis pubis; it is formed of skin, loose connective tissue, corpora cavernosa, corpus spongiosum, and the urethra, and varies in size according to the vascular condition of the corpora cavernosa.

The skin of the penis is loosely attached to the body of the organ by a connective tissue that permits great freedom of motion. At the glans penis, or anterior extremity of the organ, the skin is thrown into a duplicature or fold—**prepuce**—the inner layer of which is blended or lost in the mucous membrane covering the glans penis. In consequence of this arrangement, the prepuce consists of two laminæ, the inner of which is inserted at the base of the corona glandis. Between these two layers is a loose connective tissue, liable to a serous or lymph-like infiltration, which sometimes materially interferes with the mobility of the part. Ordinarily, the prepuce may be retracted or drawn forward so as to expose or cover the entire glans, though congenital defects or diseased action may so limit this movement as to prevent the exposure of the glans to any extent. The corpora cavernosa and corpus spongiosum are not sufficiently connected with the operations usually practiced on this part to require further reference at present.

§ 2.—The Urethra.

Although the **Urethra** is actually a portion of the structure of the penis, the direct connection existing between it and the bladder has led anatomists to describe it as if it were an appendage of the bladder. The importance of the canal, and the danger ensuing upon its obstruction, owing to its being the only channel for the escape of the contents of this viscus, have, however, led surgeons to a specific study of it, and to the establishment of certain regional divisions, the limits of which are useful, though purely optional.

The extent of the penis being very varied, a considerable diversity of opinion exists in reference to the average length of the urethra, or the true distance from its orifice to the neck of the bladder.

According to Blandin,* its length varies from eight to nine inches, as measured in a median section of a flaccid penis while laid upon the abdomen, and, of course, a little elongated.

Malgaigne,† on measuring it also in the flaccid condition, but hanging down upon the scrotum, found it to be, on an average, six, or six inches and two-fifths long. In old men, hypertrophy of the prostate augments it two-thirds of an inch, or even more.

Pancoast‡ has found that, in the negro or mulatto, the average length is about seven inches, measuring from the end of the urethra to the neck of the bladder in the flaccid penis, and about one inch more when elongated by moderately stretching the organ; but as the genital organs of the negro are generally more developed than those of the white, it may be safely inferred that six, or six and a half inches, in white men, measuring from the orifice of the urethra, should suffice to place the point of an instrument within the neck of the bladder.

The regional division of the urethra into fossa navicularis, bulbous, prostatic, and membranous portions, having reference to certain points of the genital organs through which the canal passes, does not require detailed reference in connection with operative surgery, but belongs more especially to the descriptions of special anatomy. It must, therefore, suffice to say that, according to Malgaigne,§ the prostatic portion of the urethra is from seven to eleven lines in length, and the membranous from six to nine lines, the bulbo-cavernous portion being the only part which is influenced by stretching the penis.

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* Anat. Topographique, p. 384.

† Op. Surg., Philadelphia edit., p. 467.

‡ Pancoast, Wistar's Anat., vol. ii. p. 170.

§ Op. citat., p. 469.

Henry Thompson, of London, in a recent work,* after many trials, gives the following accurate data: The greatest length of the urethra is 9 inches, and the least 7¾. The length of the spongy portion 6½ inches, of the membranous ¾ of an inch, and of the prostatic portion 1¼ inches, the average length of sixteen urethræ being 8¼ to 8⅝ inches—in the dead subject; but in the living he regards the statement of Briggs as correct, to wit, that the average length of the living urethra is 7½ to 7¾ inches.

§ 3.—The Testicles.

The **Testicles**, being suspended from the abdomen by the spermatic cord, are covered by a serous coat—**tunica vaginalis testis**—as well as by the dartos and scrotum.

The tunica vaginalis testis is generally a clear, smooth, and translucent serous membrane, which in the healthy condition secretes merely sufficient halitus to facilitate the motion of the gland, though it may be rendered thick, firm, and even osseous by disease, and, in one instance, under my own observation, was fully two lines thick, and as firm as cartilage. Under such circumstances, great caution is requisite, in treating its disorders, to prevent a mistake in diagnosis.

The cord is formed by the vas deferens, spermatic artery, veins, nerves, and lymphatics, covered in by the fatty and connective structure designated as tunica vaginalis communis, and by the fibres of the cremaster muscle.

The spermatic artery comes out of the abdomen and pursues a tortuous course to the testicles, being surrounded by and adherent to the spermatic veins throughout the extent of the cord. The spermatic veins extend from the testicles to the abdomen; are larger than the artery, anastomose freely with the superficial veins of the scrotum, and, enveloping the vas deferens and the artery, constitute the great bulk of the cord. They are without valves and largest on the left side, in consequence probably of the pressure made upon them in their passage behind the sigmoid flexure of the colon.

The surgical relations of the bladder and perineum of the male will be reserved for the account of Lithotomy, in the ensuing chapter.

SECTION II.

OPERATIONS ON THE PENIS.

The operations practiced on the Penis consist of those required for phymosis and paraphymosis, with division of the frænum, and amputation of the organ.

§ 1.—Phymosis.

When, from congenital defect, the prepuce is unnaturally elongated, and at the same time so much contracted at its orifice that it cannot be drawn back so as to uncover the glans penis, or when the orifice of the prepuce is diminished by serous and fibrinous deposits in the cutaneous areolar tissue, it constitutes **Phymosis**—*φιμος*, a muzzle—and the patient is liable to be incommoded either in voiding the urine or in sexual intercourse. The constriction of the glans penis also induces a partial atrophy or defective development of the organ. To relieve this state of the parts, several operations have been suggested, that of circumcision, as practiced by the Jews, or as slightly modified by surgeons, being the most ancient.

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* Pathology of Stricture, Jacksonian Prize, 1852.

I. **Circumcision.**—In the operation of circumcision, as originally performed, the prepuce, after being drawn forward, in advance of the end of the glans, by the fingers of the operator, was inserted in the cleft of a sort of spatula, the protruding portion excised by the sweep of a knife, and the mucous lining torn open to the corona glandis; a strip of linen, to prevent adhesion, completing the dressing.

As usually performed by surgeons of the present day, circumcision is accomplished as follows:—

Operation.—The prepuce being first drawn well forward, the projecting portion is seized in a pair of dressing-forceps, and then excised on a level with the blades of the instrument, either by means of a bistoury or scissors; a few stitches of the interrupted suture, to unite the mucous coat of the skin, and a piece of lint, completing the dressing.

Remarks.—Several slight modifications of this operation have been suggested by Velpeau and Ricord, but as they are sufficiently explained in Plate XLIX, further reference is here unnecessary.

II. **Incision.**—Various plans of slitting up the prepuce have been suggested by different operators, in order to free the glans, and yet not create deformity. The selection of one method rather than another will therefore depend mainly on the complications of the case, and especially on the existence of chancre. When chancre is present, the performance of the operation exposes the patient to a new inoculation by the freshly divided surfaces.

Ordinary Operation.—In the mode of operating resorted to under ordinary circumstances, the patient is so placed that he cannot move from the surgeon, when the latter, after carefully introducing a director between the prepuce and the glans, as far back as the corona glandis, passes a sharp-pointed bistoury along it, punctures the skin from within outward at the end of the director, and then slits open the membrane from behind forward in the median line, upon the dorsum of the organ, Plate XLIX. Fig. 2. The glans being thus exposed, it only remains to unite the fold of skin and mucous membrane together by three stitches of the interrupted suture, and treat the wound as a simple sore.

Operation of J. Cloquet.—In consequence of the wings or lateral lumps left by the preceding method, Cloquet suggested the following operation, which has since been frequently performed by Liston and others, and often spoken of as Liston's operation:—

Introduce a director between the glans penis and prepuce, on the inferior side of the organ, and place it parallel with and alongside the frænum, taking care that it is not by any mischance carried into the urethra. Then passing a sharp-pointed bistoury along it to the corona glandis, transfix the prepuce, and slit it up from behind forward on the side of the frænum, when the glans will be fully exposed, Plate XLIX. Fig. 4. After this, a point or two of the interrupted suture, made so as to unite the skin and mucous membrane on the free side of the flap, completes the operation.

Operation of Cullerier.—As the constriction of the preputial orifice is often dependent on a contracted condition of the lining membrane of the prepuce, this surgeon operated by incising only the mucous membrane, commencing at its free edge and cutting backward to a sufficient extent to permit the free expansion of the skin.

Remarks.—Although the operations for the relief of phymosis are simple, the future usefulness of the organ and the absence of evident deformity will depend somewhat upon the plan selected. Where the defect is a congenital one, the selection of the method is entirely in the power of the surgeon, and, under these circumstances, the advantages of the different plans should be well considered, especially if the patient is an adult. In the operation of circumcision, as usually practiced, the cicatrization of the wound is apt to leave such a constriction of the mucous membrane as prevents the free exposure of the gland, and has occasionally led to the production of a new phymosis. To obviate this, it will therefore be found advantageous, where circumcision is practiced, to pursue the Jewish plan of operating, and, after excising the skin, to tear up the mucous membrane longitudinally on the dorsal surface of the penis, or, as suggested by Maisonneuve, of Paris, after circumcising the skin alone, simply to incise the membrane on the dorsum of the penis to the extent of a centimetre, and cut off the angles of these flaps, uniting them afterward with the skin, as by this means the constriction of the cicatrix is prevented, in consequence of the more prompt union of the surface, and the separation of each side from the other after the angles of the wound have been removed.

Frequent opportunities of testing the advantages of the plan of Cloquet having satisfied me of its value, I do not hesitate to recommend it as that best adapted to the adult, because it fully exposes the glans, and leaves little or no lateral deformity, as is frequently the case in the dorsal incision. Should the existence of chancres near the frænum, or other circumstances, prevent its performance, and compel the adoption of the dorsal cut, I should prefer excising the two flaps and uniting the mucous membrane and skin at the line of the corona, so as to leave the glans permanently uncovered; but it is important to recollect the general rule, that "all incisions about the generative organs of a patient with chancre or gonorrhea should be avoided, the wound augmenting the danger of syphilitic inoculation or being exposed to sloughing from the irritation of the discharge that flows over it."

§ 2.—Paraphymosis.

The word **Paraphymosis**—*παρα*, back, and *φιμοσις*, a bridle—is employed to designate that state of the penis in which the prepuce is drawn back and contracts behind the corona glandis, so that it cannot be again brought forward. In many instances, this condition is owing to a difference between the development of the two layers of the prepuce, the mucous membrane being the narrowest, though it may be caused by the constricted margin of the prepuce of a phymosis being so distended by the shape of the head of the penis, that it readily slips over to the corona, but cannot subsequently be drawn forward, in consequence of the congestion and enlargement of the glans which ensue upon its constriction.

When paraphymosis is allowed to continue, the prepuce may slough, or adhesions form, so as to render the thickened folds behind the glans a great deformity. To obviate this, two means of treatment may be resorted to: one —compression—having for its object the diminution of the bulk of the head of the penis, and the immediate anteversion of the retracted prepuce; the other—incision—the division of the constricting ring or margin of the prepuce, or, if necessary, its dissection from the attachments formed behind the corona.

I. **Compression.**—After bathing the part in cold water, or keeping cold cloths constantly on it for an hour or more, compression, which is the simplest of these operations, may be attempted as follows:—

Operation.—Place a piece of soft linen upon the retracted prepuce, seize it just behind the glans between the first and second finger of each hand, so

PLATE XLIX.

OPERATIONS PRACTICED ON THE PENIS.

Fig. 1. Section of the Frænum when too short. 1. The bistoury transfixing the prepuce, so as to shave it off from behind forward.

After Bernard and Huette.

Fig. 2. Ordinary operation for Phymosis. 1. The director carried between the glans penis and the prepuce, as far back as the corona glandis. 2. The bistoury puncturing the prepuce behind, and about to slit it open on the median line from behind forward. *After Bernard and Huette.*

Fig. 3. Excision of the flaps created by the preceding operation. 1. Rat-tooth forceps holding both the mucous lining and skin of the prepuce. 2. Scissors in the act of excising the flap. *After Bernard and Huette.*

Fig. 4. Cloquet's operation, sometimes assigned to Liston, but also described by Celsus. 1. The director passed between the glans and prepuce, alongside of the frænum. 2. The bistoury slitting up the prepuce.

After Bourgery and Jacob.

Fig. 5. Ricord's operation for Circumcision. The forceps holding the prepuce in advance of the glands. 2, 2. Ligatures passed through the prepuce for the purpose of subsequently uniting the skin and mucous membrane.

After Bernard and Huette.

Fig. 6. The second stage of this operation. 1. Rat-tooth forceps drawing the prepuce forward. 2. The bistoury in the act of circumcising the prepuce.

After Bernard and Huette.

Fig. 7. Appearance of the Prepuce after Circumcision. 1, 1, 2, 2. The ligatures for uniting the wound. *After Bernard and Huette.*

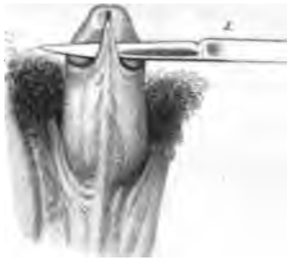
Fig. 8. Completion of the operation. 1. The first suture as applied. 2. The second ligature. *After Bernard and Huette.*

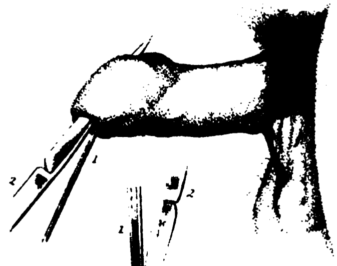
Fig. 9. Reduction of Paraphymosis by Compression. While the thumbs of the operator push back the glans, the first and second fingers draw the prepuce forward over the corona. *After Bernard and Huette.*

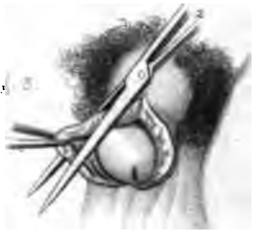
Fig. 10. Amputation of the Penis. 1. Left hand of the surgeon holding the penis enveloped in a cloth. 2. Hand of the assistant. 3. The bistoury.

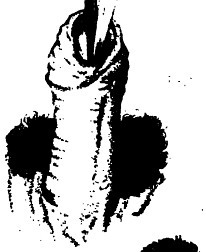
After Bernard and Huette.

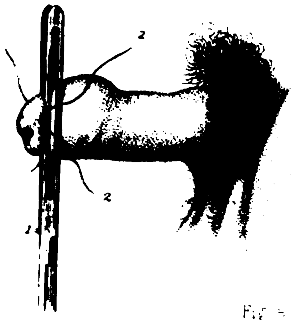
Fig. 1

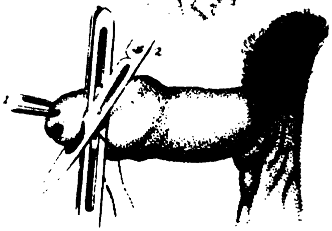


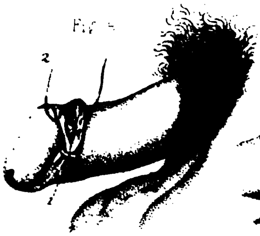


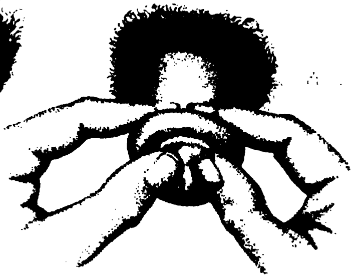












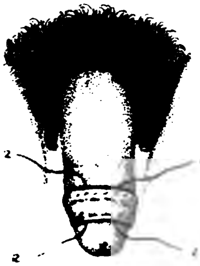
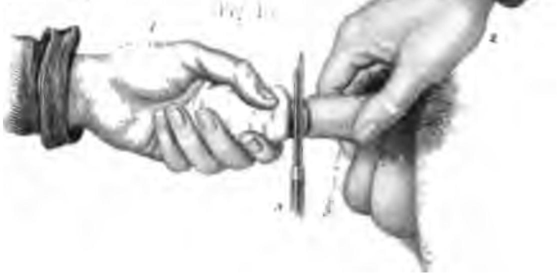


Fig. 10



as to draw it forward, and at the same time apply the thumbs against the extremity of the glans, so as to knead and force it backward, when, after a gentle perseverance, success will be obtained in most instances, especially if the attempt is made within two or three hours after the occurrence of the retraction, otherwise it will be more difficult, Plate XLIX. Fig. 9. Where there is much œdema of the prepuce, and the mucous membrane is highly tumefied, it may be necessary, and I have often found it advantageous, to puncture the membrane at numerous points, so as to give exit to the serum and allow of the more ready movement of one layer of the prepuce upon the other, after which compression should be made as before directed.

II. **Incision.**—When the constricting prepuce is so tight or the adhesions so close that it cannot be made to yield to the force applied through the fingers, it may become necessary to resort to the knife.

Operation of Incision.—Let one assistant retract the skin of the penis as much as he can toward the pubis with one hand, and draw the prepuce forward with the other so as to display, if possible, the seat of stricture, after which the surgeon may nick it with a bistoury, either by cutting from behind forward, or introducing a director and dividing the stricture upon it; or, what is more easily done, make a vertical cut through the prepuce from above downward and from the mucous membrane to the skin, until the constriction is freely removed. The latter operation, by enlarging the prepuce, prevents a reproduction of the disease.

§ 3.—Division of the Fraenum.

When from congenital defect the frænum extends as far forward as the extremity of the urethra, it may depress the point of the glans, and cause inconvenience in sexual intercourse; or the irritation and laceration of the part, or mental anxiety in regard to the defect, may lead the patient to insist upon its division. Under these circumstances, the operation for its relief may be performed as follows:—

Operation.—After arranging the patient so that his motions can be controlled, retract the prepuce, and let an assistant hold it back and support the penis, while the surgeon, drawing the frænum from the glans with his left hand, transfixes it with a bistoury held in the right, Plate XLIX. Fig. 1, so as to cut from behind forward and shave it off. A piece of linen to prevent adhesion is all that is subsequently requisite; or the surface may be lightly cauterized.

§ 4.—Amputation of the Penis.

Amputation of the Penis may be demanded by cancer, gangrene, etc., though cancer is the most frequent cause of its performance. As the symptoms, etc. of cancer have been already alluded to,* attention may now be given solely to the operation sometimes practiced for its relief, with the result usually attendant on operations for cancer elsewhere. When demanded, the anatomical relations of the organ should be borne in mind, especially the loose attachment of the skin, and the tendency of the penis to shrivel up and contract upon itself, after being stretched. The latter circumstance is often a source of trouble where means are not taken to obviate it, the surgeon being worried by the unexpected difficulty found in arresting the bleeding, or annoyed by the excess of skin over the stump, in consequence of his elongating the organ during his incisions. When the amputation is to be performed low down, or near the pubis, especial care should be taken to avoid drawing the skin too much forward, lest that over the pubis or scrotum be removed unintentionally.

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* Vol. i. p. 405.

Operation.—Having prepared a small catlin, together with ligatures, tenaculum, and forceps, the hair should be shaved from around the part, and the glans and free end of the organ wrapped in a bandage so as to give the operator a good hold upon the member. Then, while the patient is in a convenient position, the surgeon, without drawing upon the portion held in his left hand, should pass the catlin rapidly round so as to divide the skin, Plate XLIX. Fig. 10; then cut through the upper part of the corpora cavernosa, ligate the arteries, and, resuming the knife, finish the operation by dividing the remainder of the organ at one sweep.

Dressing.—After arresting the hemorrhage, the mucous membrane of the urethra should be fastened to the outer margin of the stump by two or three points of the interrupted metallic suture, when a catheter should be passed into the urethra, and the stump dressed like any other stump, the catheter serving to keep the patient dry and steady the organ during the dressing. As, however, the urine will do no harm to the wound, and irritability of the bladder may render the use of the catheter objectionable, a resort to it must be decided upon at the moment by the judgment of the operator.

Operation by the Ecraseur.—Chassaignac, of Paris, advises the amputation of the penis by the écraseur, and it has been frequently employed satisfactorily both in Europe and the United States, there being but very trifling hemorrhage, and the union of the stump being prompt. In its use inclose the penis in the loop of the instrument, and constrict it slowly for twenty minutes, or until it cuts through the organ.

Remarks.—The performance of amputation of the penis at the pubis does not differ materially from the plan just detailed for the operation upon the body of the organ. An elliptical incision will, however, be preferable to the circular one above mentioned, care being taken to avoid encroaching too much upon the skin of the scrotum. When the penis is removed near the pubis, the patient is also more apt to be annoyed by the urine passing upon his thighs and perineum, unless he places himself in a sitting position, or employs a funnel of metal or gutta-percha adapted to the part, as advised by Ambrose Paré. Under all circumstances, the mental depression after the operation is often sufficient to prevent proper digestion and assimilation, and the return of a malignant disorder being thus hastened, it may be doubted whether, in the case of cancer, anything is gained by the operation. In one patient, in whom I amputated the entire penis, though life lasted for nearly two years after removal of the organ in consequence of cancer, his existence was one of extreme unhappiness, the man being constantly distressed by mental anxiety and bodily pain, and the disease showing itself in the stump in a few weeks after the amputation. The operation by the écraseur has no advantage over the other methods, except the few days' shorter time that is required for the healing process.

SECTION III.

OPERATIONS ON THE URETHRA.

The necessity of passing through the urethra in order to accomplish the treatment of some of the complaints of the bladder, has caused many operations to be placed under this head that do not strictly belong to this region;

such, therefore, as involve disorders of adjacent parts may be advantageously referred to a subsequent section. At present, those of catheterism, stricture, and congenital malformations of the canal will alone be considered.

§ 1.—Catheterism.

The evacuation of the bladder through the hollow tube called a catheter constitutes the operation of **Catheterism**, and is one which, in the normal condition of the canal, and in skillful hands, is easily performed. Various details may, however, be given, in order to facilitate the progress of those who are inexperienced.

Catheters.—The selection of the catheter—either of silver or caoutchouc—is so purely a matter of personal opinion, that nothing need be said in reference to the material, except to discountenance the use of gutta-percha, which is dangerous from its brittleness. When the surgeon, especially in the country, is so placed as to find it desirable to evacuate a patient's bladder while unable to obtain the regular instrument, the following practice, suggested and occasionally advised by Physick, of Philadelphia, may prove worthy of being noted. In a case of great emergency, this distinguished surgeon resorted to a common article of dress, and formed a catheter by regularly extending the elastic spiral wire often found in the suspenders of gentlemen, covering it with a piece of muslin which had been dipped in melted beeswax, and then cutting eyes near the point.

Another excellent contrivance, suggested by a surgeon in the United States whose name has escaped my recollection, is to hammer out a piece of sheet-lead, and, rolling it round a large knitting-needle, afterward make eyes in it as required.

A method of treatment that has proved effectual in cases of retention of urine from spasm, and which may be employed even when the surgeon cannot obtain a catheter, is the injection of warm sweet oil into the urethra, as suggested by Hewson, of Philadelphia. The point of an injection syringe being introduced into the urethra, and the canal held closely around it by an assistant, gentle and steady pressure upon the piston will force the warm oil to the neck of the bladder, where its pressure will often suffice to induce relaxation of the spasm. The bladder may also sometimes be induced to void itself by pouring, slowly, cold water upon the sacrum and loins for a few seconds, so as to excite the spinal nerves; but most frequently it is easiest to employ a catheter.

Ordinary Operation of Catheterism.—While the patient is lying down, with the shoulders elevated, the knees flexed, and breathing freely, so as to insure relaxation of the abdominal muscles and prevent straining, the surgeon should place himself upon the left side of the patient, oil the instrument, and seize the corona glandis between the ring and second fingers of the left hand in a state of supination, Plate LI. Fig. 1, or between the forefinger and thumb. Then seizing the handle or end of the catheter with the right hand, so that the back of the fingers may be below or next to the abdomen and the thumb on top, introduce the point of the instrument into the urethra, holding the penis perpendicularly to the pubis, and the body of the instrument parallel with the median line of the abdomen, with its concavity presenting to the pubis. After passing the point a short distance into the canal, gradually elevate the right hand, and, keeping the point of the instrument in contact with the superior side of the urethra, press the catheter toward the bladder, bringing its handle or free end from the horizontal to the perpendicular position, so as to cause the point to pass through the bulb of the

PLATE L.

INSTRUMENTS FOR OPERATIONS ON THE URETHRA.

Fig. 1. A Male Silver Catheter. The eye is better than the perforations usually made, as such an opening will not clog with mucus. *Kolbè's pattern.*

Fig. 2. Curve of the Catheter adapted to old men with enlarged prostate. *After Dorsey.*

Fig. 3. Small Silver Sound for the purpose of dilating or detecting a stricture of the urethra. *Kolbè's pattern.*

Fig. 4. Largest size sound for same purpose. " "

Fig. 5. Smallest size of the instrument. " "

Fig. 6. Flexible Lead Bougie for dilating strictures; it may be retained in the bladder many hours without creating irritation. *Kolbè's pattern.*

Fig. 7. French Bougie, with a "porte empreinte" for taking a cast of a stricture. 1. The "porte empreinte," or mould. *From the instrument.*

Fig. 8. Amussat's instrument as applied to dilate a stricture; being introduced closed, the loop is expanded by the screw. *Kolbè's pattern.*

Fig. 9. Chew's Stylet for dividing stricture; it is to be introduced into a silver catheter, like Fig. 14. *Kolbè's pattern.*

Fig. 10. French pointed Gum-elastic Bougie for dilating stricture. *From the instrument.*

Fig. 11. Physick's Stylet for incising stricture in the spongy portion of the urethra. 1. Slide to move the blade. *Kolbè's pattern.*

Fig. 12. Steel Bougie silvered, and of double curve, to dilate strictures; there are two ends, of different sizes, embraced in each instrument. *Kolbè's pattern.*

Fig. 13. Lallemand's Porte-caustic for cauterizing the urethra. 1. Cup for the caustic. *Kolbè's pattern.*

Fig. 14. A Curved Catheter and Stylet for dividing strictures near the neck of the bladder. *Kolbè's pattern.*

Fig. 15. Extra end of another curve. " "

Fig. 16. Physick's Bougie Catheter for entering the bladder in cases of stricture. *After Dorsey.*

Figs. 17, 18. Shape of the piece of waxed cloth before it is rolled into the bougie, and attached to the catheter. *After Dorsey.*

Fig. 19. The complete instrument. " "

Plate 50.

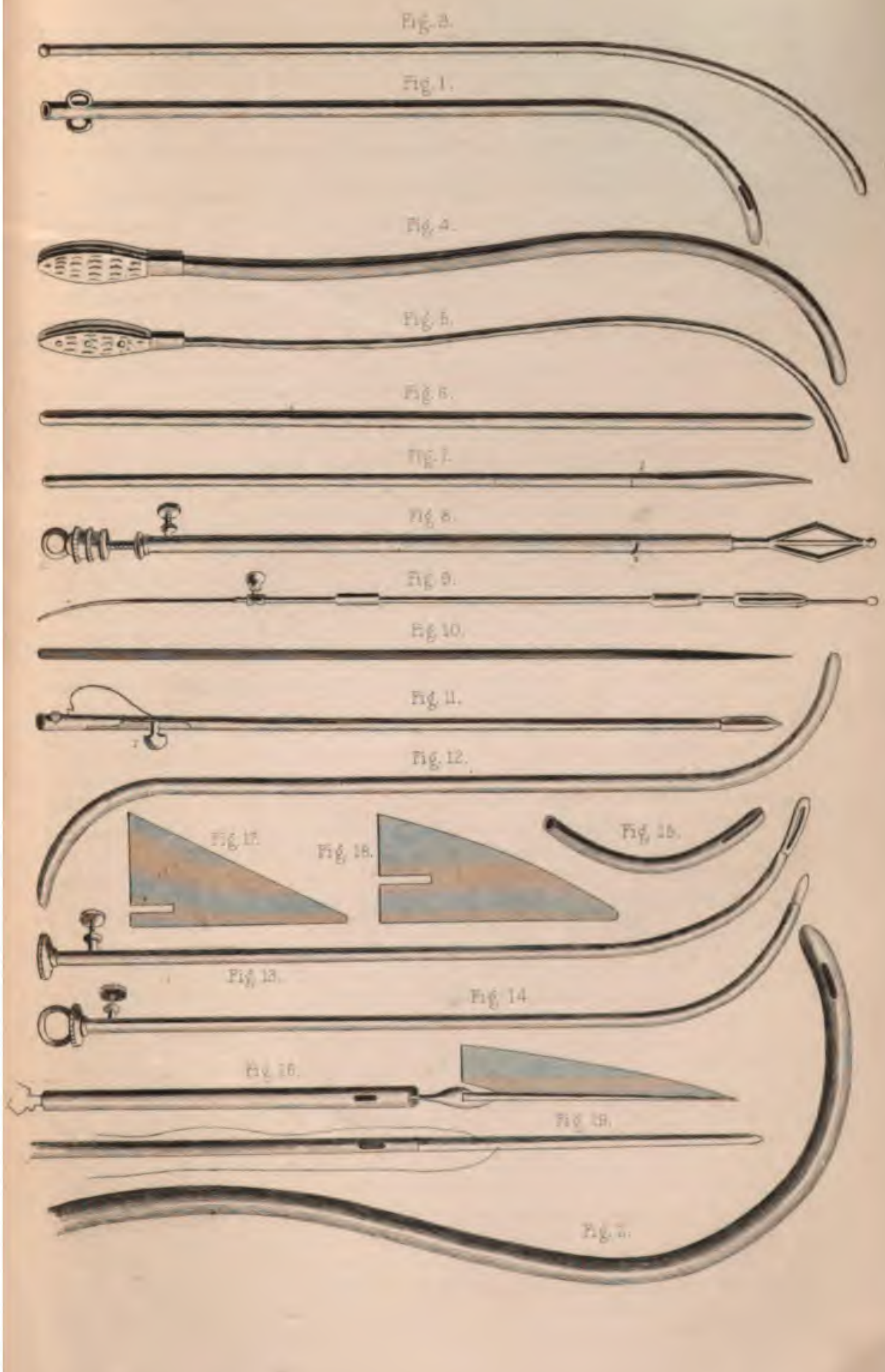

Fig. 2.
Fig. 1.
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Fig. 17.
Fig. 18.
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Fig. 13.
Fig. 14.
Fig. 16.
Fig. 19.
Fig. 3.

urethra. Then, gradually depressing the handle so as to bring the shaft parallel with the thighs of the patient, cause the point thus to mount over the triangular ligament, when the gush of urine may be checked by the thumb placed over the orifice of the instrument until a vessel is held to receive it. In this movement, the end of the instrument should be made to describe the arc of such a circle as will enable the point to pass readily behind the pubis, as is shown in Plate LI. Fig. 4. After evacuating the bladder, keep the end of the catheter closed with the thumb until the instrument is removed from the patient and held over a vessel, when, on freeing it, the urine which has filled the instrument will escape without soiling the patient.

The "Tour de Maitre," or "Master-stroke," consists in passing the catheter through the spongy and bulbous portion of the urethra, with its mouth presenting to the patient's feet and with the convexity of the instrument toward the pubis. Then, on reaching the perineum, turn the catheter rapidly around so that its concavity will be toward the pubis, and, rapidly depressing the handle of the instrument, slip its point quickly into the bladder. This ad captandum movement does not possess a single advantage over the plan just described, and savors somewhat of charlatanism. All rapid movements in the introduction of instruments into the urethra should be discouraged, as they unnecessarily expose the patient to danger from the laceration of the canal, or from the creation of a false passage. Some surgeons, when passing the catheter, prefer that the patient should stand up, with his back against a wall, while they seat themselves in front of him, but the recumbent posture of the patient has always been the most convenient to me. In the introduction of the catheter in irritable patients, even when not laboring under any organic change in the course of the urethra, the mere passage of the instrument with all possible gentleness will sometimes be followed by severe constitutional disturbance, such as rigors and fever, or by symptoms of local irritation, as a muco-purulent discharge or epididymitis. These symptoms, being usually evidence of neuralgic irritation transmitted to the spinal system of nerves, may be best alleviated by warm hip-baths; by anodyne enemata, such as laudanum and starch; by a full dose of Dover's powder, and by rest in a warm bed, with the testicles supported by a suspensory bandage; or by leeches to the perineum, and the application of warm cloths, though most frequently rest and an anodyne will suffice without the employment of the other measures. Should the chill and fever be reproduced on the second or third day, a full dose of quinine will be demanded as in ordinary intermittent fever. When difficulty has been experienced in the introduction of a catheter, it may be retained in the bladder for two or three days, by attaching tapes to a ring or bandage around the penis, a plug being placed in the instrument so as to prevent the constant escape of the urine.

Under ordinary circumstances, or when the urethra is in its normal condition, the introduction of the catheter cannot prove a difficult operation to any one who is familiar with the anatomy of the urethra. As a certain amount of dexterity is, however, only to be gained by practice, the student should endeavor to introduce an instrument into the bladder whenever he has the opportunity in the dissecting-room. In a healthy subject, practice will soon give the hand its cunning, while the difficulties occasionally met with in the patient may be prepared for by a little study of the diseases of the urethra as found in the monographs on this subject, or by a reference to the brief mention of them to be found in the following section.

Obstacles to Catheterism.—Although, as just stated, the introduction of an instrument into the bladder is, under ordinary circumstances, a very easy operation to one perfectly familiar with the anatomical relations of the part, it may be rendered one of great difficulty in consequence of certain peculiarities which will now be mentioned.

If the instrument is a fine one, its point is liable to enter and be held by an enlarged lacuna: to obviate this difficulty, withdraw the catheter a little and elongate the urethra by stretching the penis. Or the point of the instrument may pass readily as far as the membranous portion of the urethra, and hitch there in consequence of its being made to bear too much on the inferior side of the urethra, from the too sudden elevation of the handle; or the point may be carried so as to strike against the lower edge of the triangular ligament. In these cases, when difficulty is experienced, the young surgeon should be especially cautious as to the amount of force that he employs to overcome it, as it is very easy to drive an instrument through the membranous portion of the urethra, and thus carry it between the bladder and rectum, or make a false passage and create a perineal fistula in consequence of the point of the instrument being thrust into the perineum, or even, as I saw in one instance in the hands of an ignorant practitioner, brought out at the *tuber ischii*. Again, especially in old men, there may be such a condition of the third lobe of the prostate as will prevent the entrance of the instrument into the bladder, in consequence of this enlargement of the gland, a fact that may be partially diagnosed by feeling the prostate through the rectum.

To overcome the difficulty created by an enlarged lobe of the prostate, it is absolutely necessary that the *point* of the catheter should be made to curve upward a little more behind the pubis than is usually required, and various means of accomplishing it have therefore been suggested. The simplest of these is to introduce the left forefinger into the anus and press up the point of the instrument, while its free end is gently depressed to the level of the thighs; or where the flexible catheter with a wire stylet is employed, to resort to the expedient by which Hey, of England, accomplished the same object, that is, gently withdraw the wire a little, and push the catheter onward, a practice which has often proved successful. The proper shape of a metallic catheter for an enlarged prostate may be obtained by introducing the point of its curve or the end of the wire, if an elastic instrument, into the tube of a key for the extent of a quarter of an inch, and then gently bending up the point.

As a flexible wax bougie, by adapting itself to the condition of the part, will often pass more readily than a catheter, Physick was accustomed to attach a bougie point to the ordinary catheter in the following manner:—

Physick's Bougie Catheter.—Cut off the point of a flexible French (gum-elastic) catheter, so as to leave the canal open throughout the instrument; then rolling up a piece of waxed linen so as to form a conical pointed bougie, make a slit half an inch long in its lower end, so that the rolled part may be inserted into the catheter. The other portion of the linen being now wrapped around the outside of the instrument, and fastened with a strong thread, Plate L. Fig. 16, the latter should be stitched through the end of the bougie and brought out of the open end of the catheter, so as to secure the extraction of the point, if accidentally broken off. This bougie catheter is readily made, and will often serve the purpose of evacuating the bladder better than any other instrument.

With patience and gentleness combined with practice, most of the difficulties attendant on the passage of a catheter through a diseased urethra may be overcome. Those consequent on irritability of the canal, or a spasmodic contraction of the perineal muscles, or, as it is sometimes called, a spasmodic stricture, yield usually to gentle and continued pressure of the catheter, especially if the patient is etherized, and offers no resistance to the use of the instrument. Those due to stricture of the urethra require the means spoken of under this latter head. In all cases requiring the use of a metallic or bougie catheter in cold weather, it will prove useful to warm the instrument and grease it thoroughly with lard in preference to oil before using it.

Occasionally it happens that a catheter, even when well placed in the bladder, will not evacuate its contents, in consequence of the over-distention of the viscus. As this effect is due to temporary paralysis of the muscular coat, it may be necessary for the surgeon to make gentle pressure over the pubes in order to aid in the evacuation of the urine.

In some instances, it happens that a surgeon is called upon to pass the catheter in a patient who has previously been injudiciously treated, and whose urethra has been torn by the forcible attempts at the introduction of an instrument so as to create a **false passage**. In treating such cases, great care is necessary in order to obviate the tendency of the catheter to enter the false route instead of passing along the true one. With an accurate knowledge of the urethra and a light touch, any deviation of the point of the instrument may, however, be readily told and obviated by withdrawing the instrument a little, elongating the urethra, and then passing the catheter onward, while its point is kept closely applied to the upper or lateral portions of the canal, the false route being nearly always found on the inferior surface of the urethra in consequence of the practitioner bearing the point of the catheter too much toward the perineum, after it has passed the bulb. Two-thirds of the false passages will also be found at or near the bulb, or in the membranous portion, or in advance of the triangular ligament, in consequence of the too rapid elevation of the instrument from the level of the abdomen.

SECTION IV.

STRICTURES OF THE URETHRA.

Stricture of the Urethra consists in such a diminution of the normal calibre of the canal as interferes with the proper performance of its function. As the spasmodic stricture has been alluded to under the head of Catheterism, the permanent variety now demands attention.

Permanent Strictures of the Urethra, as already stated,* are those which are due to such morbid changes in the parietes of the canal as result in diminution, until at last it offers a marked obstacle to the escape of the urine from the bladder. The latter variety of strictures, being due to chronic inflammation in the part, is usually designated as permanent strictures, and may be developed by any cause capable of inducing inflammatory action in or around the mucous coat of the canal. Whether this action produces a simple bridle or thread-like deposit, or one of greater breadth and extent, there is usually noted more or less thickening of the mucous membrane, as well as solidification or induration of the adjoining tissues. In front of a stricture there may be but little departure from the normal condition of the lining membrane of the urethra up to the edge of the obstruction; but behind it the canal is often considerably dilated, either throughout its circumference or on one side, while the adjoining lacunæ and entire mucous coat indicate the effects of these changes, by their various departures from the natural state. It has also been asserted that softening and dilatation are often present at one or more points adjacent to the stricture of the urethra as well as in that of the œsophagus.

Diagnosis.—The existence of stricture, though often indicated by the marked symptoms previously stated, can only be accurately told by such an exploring operation as brings an instrument directly in contact with the obstruction. To do this correctly it is essential that the operator should have a correct knowledge of the natural relations of the part; that the bougie, sound, or catheter first employed be sufficiently large to distend the canal and thus enable its point to escape the orifice of any enlarged lacuna, and that the ordinary difficulties referred to in catheterism be borne in mind, especially the liability to error caused by depressing the handle of the instrument too soon, or before its point has reached the triangular ligament of the urethra. Two other sources of mistake in regard to stricture, and which may lead us to infer their presence when they do not exist, must also be remembered. One is that the flaccid state of the urethra is liable to produce transverse folds in the canal, especially near the bulb, which folds may stop the end of a bougie, while a deep depression, naturally existing at the back of the prostate, will, by receiving the point of the instrument, arrest its progress. A careful examination with the finger introduced into the rectum is necessary in order to prevent or correct both of these errors, and enable us to pass the instrument onward. After establishing the seat of a stricture it is also essential that its extent, character, and permeability be accurately learned before deciding on the plan of treatment.

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* Vol. i. p. 310.

Various means have been suggested in order to demonstrate accurately the character, situation, and condition of a stricture, among which the use of soft bougies, or those formed of waxed linen, have been the most prominent. When one of these instruments—of the full size—is oiled, carried down to and pressed firmly against a dense stricture for a few minutes, it softens by the heat of the body, and takes such an impression as will show accurately the position of the obstruction. But as the less dense strictures are incapable of marking their own position upon such an instrument, the following plan, which is a slight deviation from that suggested by Ducamp, will prove serviceable:—

To take a Cast of a Stricture.—Take a piece of silk ribbon about two inches wide and three inches long, and cut it obliquely across, Plate L. Fig. 17; then pull out all the transverse threads to within three-fourths of an inch of the length of the piece; next melt equal parts of beeswax, shoemakers' wax, and resin in a cup; fasten the sound part of the ribbon to a wax bougie by a stitch, or by thread wound around it, and, dipping it into the melted mixture, saturate the longitudinal threads of the ribbon with the wax; dip this into cold water, and then mould it, by pressure with the thumb and fingers, into a conical shape, Plate L. Fig. 7. On carrying a bougie thus armed down to a stricture and pressing it gently against it, a perfect cast of the part may be taken, provided the bougie and waxed end are large enough to fill up the canal.

Treatment.—Having thus learned the character and position of the disease, attempts may now be made to overcome it, either by dilatation, incision, or the use of caustic, the selection of either plan being decided by the character of the obstruction, or the peculiar circumstances of the case. Dilatation is especially applicable to recent, and not very contracted strictures, or to patients who can be kept under treatment a considerable length of time, or have sufficient intelligence and judgment to enable them to continue the introduction of an instrument after they have left their surgeon. Incision should seldom be employed except in old, dense, and almost impermeable strictures, where the patient can be subsequently watched; and caustic proves most useful in similar cases where, from the position of the stricture, its puncture would be attended by great uncertainty, as in the membranous portion of the canal, or in those patients in whom the alterative effect of the caustic may lead to a modification of the surrounding tissues and the possibility of continued dilatation. The value of these different means of treating stricture have been variously estimated, some surgeons preferring one plan, some another, and some a combination of all. I shall, therefore, describe them separately, and state the estimate of their value subsequently.

I. **Dilatation.**—Dilatation of a stricture consists in expanding it by the introduction of such an instrument as is capable of entering within the limits of the constriction, and can only result from the application of a force which shall act from within. It is evident, therefore, that this mode of treating the complaint is only applicable to such strictures as are sufficiently patulous to permit the entrance of the dilating instrument, and sufficiently flexible to allow of the distention of the parietes of the canal. Dilatation is, therefore, usually accomplished by first passing a large metallic sound or flexible bougie down to the stricture, in order to show its distance from the fossa navicularis; then passing one sufficiently fine to penetrate it, and then another, each of them being allowed to remain a few minutes at a time, unless they cause great irritation, or constitutional disturbance, when they should be withdrawn, and not replaced until next day. If they do not excite too much irritation, each sound may be followed by one of greater bulk, until at last the stricture is sufficiently distended to permit the free passage of the urine. In some instances, surgeons have advised the employment of special dilators; thus, Arnott, of England, employs an instrument which he terms a "fluid dilator;" Perrève, of Paris, recommends a two-bladed steel dilator, the blades of which are introduced closed, and then made to expand by a screw at the free end. A similar one has been also advised by Holt, of England; while Wakley,* of London, uses a series of hollow tubes, each of which is passed over the one first introduced, so as gradually to increase its thickness. Parrish, of Philadelphia, recommended† a tapering silver bougie; but I have invariably employed the ordinary medium size round-pointed silver catheter, and deem it more certain and safer than all other instruments.

Bougies made of the bark of the **Ulmus Fulva** have also been suggested within the last few years by Waters, of Maryland, and by McDowell, of Missouri, as especially advantageous in dilating strictures; but personal experience has shown me that they are brittle, dangerous, and have no advantage over the bougie of gum-elastic. Those of gutta-percha are also brittle, and have broken off in the canal.

Operation of Dilatation.—In order to treat a stricture by dilatation, the surgeon should first give his attention to the preparation of the general health of the patient, and especially to the condition of his digestive organs, so that there may be no irritation subsequently excited by the passage of phosphatic, or otherwise disordered urine. Then, if the patient is irritable, let his nervous system be quieted by gentle anodynes and the use of the hip-bath, with rest, or let anæsthetics be employed during the operation. Having thus attended to the constitutional treatment, let such an instrument be selected as the operator deems best—my own preference being for the solid metallic bougies, with a broad handle like a sound, and a smooth and slightly tapering point, Plate L. Figs. 4, 5—and after warming and greasing it, carry it down to, and if possible within, the stricture, retaining it there for a few minutes; or, if this cannot be accomplished, carry it to the face of the stricture, and allow it to remain there as long as the patient can bear it without inconvenience, whether it be five minutes or two hours, though usually few

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[*] London Lancet, vol. i. 1851.

[†] Surgical Observations, p. 295.

persons will be able to sustain the pressure of the instrument either within or against a stricture more than half an hour at a time, and some, only half a minute. If the patient, on the contrary, is "case-hardened," most of these precautions may be omitted, and the instrument be passed to the stricture, held there a few minutes, removed, and then the patient permitted to attend to his ordinary avocations, if not of too laborious a kind. Many patients walk to the surgeon, have a bougie passed, and travel about all day without inconvenience; while others will have rigors and the constitutional disturbance referred to in connection with catheterism, from the gentle introduction of the most highly-finished instrument. Sudden and forced dilatation of a stricture has been advised by some of the European surgeons, and occasionally proved useful; but it is a dangerous plan of treatment, even in skillful hands, and no others should attempt it, as it has very often resulted in a "false passage." Very often the single introduction of a bougie through a stricture will be followed by benefit, but generally the operation must be repeated for many months, until absorption removes the disease. The further observations on the treatment of dilatation will be reserved for the end o this section.

II. **Internal Incisions.**—The internal division of stricture is especiall applicable to such cases as are too dense to admit of dilatation, or so tig or so situated as to render it difficult or impossible to enter them with bougie. In these cases, it has been suggested to cut through the indurati by means of a lancet applied so as to act through the urethra itself. Su an incision is especially demanded in cases where it is required to evacuat the bladder promptly, or in those where the resistance forbids the hope any advantage from dilatation.

Instruments.—Among the various instruments resorted to by surgeo for the purpose of dividing a stricture in the canal, I shall select as especiall useful the lancet or stylet catheter of Physick, of Philadelphia, and that Chew, of New Orleans.

Physick's Stylet Catheter for Dividing Strictures.—This instrume consists of a silver catheter, curved so as to pass readily as far as the stri ture, in which is concealed a lancet that may be protruded at pleasure, Plat L. Figs. 11, 14.

Operation.—The catheter being passed down to the stricture, is presse against the obstruction, the lancet protruded to the extent of two or thre lines, so as to cut into the thickened part, the blade retracted, and th catheter again pushed forward in the opening thus made, until at last it ca pass beyond the obstruction, and restore the permeability of the channel. common catheter being afterward introduced, should be allowed to remain few days, until the incisions have healed; when, by repeated introduction of a dilating bougie, the subsequent contraction of the part may be pre vented.

Chew's Instrument for Incising and Dilating a Stricture.—A usefu modification of the stylet of Physick may be found in the instrument o Chew, of New Orleans, Plate L. Fig. 9. This instrument consists of a silve catheter, open at the point, and split so as to permit a double-edged knife to be projected from it. The point of the knife is blunt, and pierced for th passage of a probe-pointed wire. The knife and probe being closely with drawn within the point of the catheter, the latter is passed down to th stricture, the probe, gradually protruded, passes within it, and the knife guided in the proper course by the probe, pushed on gradually, until i divides the stricture; when, being retracted, the catheter is pushed on int the bladder, and the parts subsequently dilated by the constant use o bougies.

Maisonneuve's Method of Dividing Strictures from within.*—The patient lying in the usual position, an elastic bougie is introduced through the stricture. "This bougie is slightly tapering, having upon its greater end a metallic ferrule. As soon as the stricture has been fairly passed, a small-sized silver instrument, looking like a nearly straight catheter, is to be screwed on to the metallic ferrule of the bougie, and then gradually introduced into the urethra, pushing the bougie before it, so that the latter curls itself up in the bladder, after having acted as a pioneer or guide for the silver instrument. The silver instrument, having passed through or well into the stricture, is then to be held steadily until a stylet sliding in a groove is passed down the catheter to the stricture, which it *partially* divides. This cutting instrument has an almond-shaped edge, which cuts from the *lower side* of the grooved canula, and *not* from its *end*, as *that* is obstructed by the insertion of the ferrule of the bougie. The stricture being now partially divided, the whole apparatus is then withdrawn, and another flexible bougie, which is generally *conical*, having the calibre of its main body considerably larger than the bougie first used, is then passed in the same manner as the preceding, and with about the same ease, owing to the already partially divided condition of the stricture. The *large* urethrotome is then screwed upon the bougie, as the other was in the first instance, and pushing, in the same manner, the bougie before it, enters the stricture. The urethrotome being passed sufficiently through the constriction, the concealed blade is opened, and the stricture divided completely. The urethrotome and bougie being then removed, a large-sized steel sound can be readily introduced. * * * * The proportion of deaths is said to be one out of every *four* thus treated."

Remarks.—The advantages of the treatment of stricture by internal incision, like that by dilatation, being also a point on which there is a diversity of sentiment, the estimate of its value will be deferred till after the consideration of the other means of treatment. Should the operation of internal incision create severe constitutional disturbance, it must be counteracted by the employment of the means advised in the use of the catheter.

III. **External Incisions.**—In some cases of stricture where it has been found impossible to pass an instrument, and especially in patients who had stricture in advance of the bulb, the older surgeons made a button-hole incision from without inward, as follows :—

Operation.—A director or sound, being passed down to the stricture, was there held by an assistant, while the surgeon made an incision, through the inferior portion of the parietes of the urethra, to the point of the sound. Then directing the patient to endeavor to urinate, the surgeon passed a probe in at the bottom of the wound, and searched for the portion of the urethra behind the stricture, or cut backward until he found it; after which a catheter was carried into the bladder through the penis, and the opening in the urethra closed upon the catheter by sutures.

Remarks.—This operation having been occasionally demanded, its performance has been followed by results of a satisfactory kind in a class of cases which appeared otherwise to be hopeless, and under slight modifications has been recently brought again into notice by Syme, of Edinburgh, and excited warm discussion as to its dangers and advantages. The modification of Syme, and his advocacy of its merits, having given this operation the authority derivable from the name of him who so warmly urged its value, the modified operation is frequently spoken of as Syme's operation. A similar method was, however, practiced in the United States, and ably advocated by Jameson, of Baltimore, in 1828, but was generally received with little favor, owing to the difficulties attendant on its performance, even in able hands.

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* Letter from Paris, by G. Luckley, M.D., N. Y. Journ. of Med., vol. iv. 3d series, p. 341, 1858.

Syme's Operation.—Introduce a grooved director through the stricture, which may generally be dilated to receive this instrument. Then, placing the patient upon his back at the edge of the bed, and with his knees held up, make an incision about an inch and a half long in the middle line of the perineum, (in advance of the bulb of the urethra,) so as to admit the knife to the groove in the director, and slit up the thickened texture to the extent of an inch or two, if necessary. Then passing a No. 8 catheter into the bladder, retain it there for at least two, but not more than three days. After the withdrawal of the catheter, the urine will now and then escape through the wound, but it soon diminishes to a few drops, and gradually resumes its proper course. A full-sized bougie must, however, be subsequently passed every three or four weeks, in order to maintain the cure.

A curious train of symptoms, consisting of severe rigors, bilious vomiting, suppression of urine, and delirium, have sometimes supervened on the withdrawal of the catheter; but Syme thinks them of slight importance, as it only requires, in his opinion, time and patience to remove them.

Miller, of Edinburgh, who attended a patient with Syme, thinks them, on the contrary, very serious, having found these operations to be followed by a perineal abscess which required to be opened, by a pelvic abscess which opened into the rectum, and by a painful as well as protracted and critical recovery.

Remarks.—The treatment of strictures of the urethra by external incisions is a question which has lately been warmly discussed, especially in connection with the method of operating, which, as just stated, is named after Syme, though the principle is quite an ancient one, having been recommended and practiced in 1650, and revived in 1811 by Chevalier, again by Arnott in 1822, and again by Sir B. Brodie, as well as by Jameson, of Baltimore, in 1828. Many objections have been raised to this operation, and supported to some extent by cases which indicate its dangers, such as the risk of hemorrhage, of perineal infiltration, and of abscesses. The opinion of most surgeons in the United States coincides, I think, entirely with that expressed by Solly, of London, in relation to this operation, to wit, that where it is possible to introduce a grooved director, it is also possible to pass a bougie and relieve the patient by dilatation. As Syme only claims the applicability of his operation to cases where the stricture is in advance of the bulb, many will be found to which it is not suited. In patients who have stricture of the membranous portion of the urethra, or who have the canal almost entirely obliterated at the seat of stricture, or who have the winding corkscrew stricture sometimes seen, or have perineal fistula, this operation cannot be readily employed. But when the stricture is in advance of the bulb, when the submucous and spongy structures around the canal are converted into a hard fibrous mass, or when the constriction seems to be composed of a fibro-elastic tissue like India-rubber, which, though readily dilatable, yet soon contracts, the external incision may be, in the opinion of Coulson, advantageously resorted to. It should, however, be recollected that in Syme's operation death has ensued from purulent infection, as well as from hemorrhage, and that it has almost followed the subsequent perineal and pelvic abscesses. If with these results before him, the surgeon yet deems the other means of treatment objectionable, he should bear in mind the importance of preventing the urine from escaping within the perineal fascia, and infiltrating the surrounding parts. As in any incision, dilatation is requisite in order to maintain the cure after the operation. I would generally prefer to use the stylet catheter of Physick, before mentioned, rather than make an external wound. But if an external incision is essential, and a director can be passed through the stricture, it is, of course, much safer to operate in the manner directed by Syme, that is, by cutting on the point of a sound, previously introduced into the canal, and, if possible, into the stricture itself.

IV. **Caustic in Strictures.**—The removal of permanent stricture by the creation of a slough from the application of caustic, is a mode of treatment that has much to recommend it, as it destroys the extreme sensibility of the canal, and stimulates local cell action to a change of structure. By the slight cauterization of the urethra by the nitrate of silver, its extreme sensibility is sometimes so diminished that an instrument will pass without much difficulty in the so-called "irritable strictures." But in most cases of permanent stricture a more active caustic is demanded, and may be applied by means of various instruments, according to the character, position, and extent of the stricture; the principal object being to retain the caustic in contact with the constricted part sufficiently long to produce an eschar. When caustic potash is employed, twenty seconds will usually be sufficient; after which its further action should be arrested by injecting sweet oil. If the nitrate of silver is used to create a marked slough, from one to two minutes may be required, the time varying according to the density of the stricture and the inflammatory tendency of the patient; but great care is necessary to insure the proper application of any caustic, and limit its action to the diseased structure.

The instruments employed to introduce these caustics have been very varied, but need not be specially referred to, the selection of any one being influenced mainly by the judgment of the operator. I shall, therefore, merely mention the mode of applying caustic recommended by Ambrose Paré and Hunter, as it is one which experience has taught me is sufficient for the ordinary varieties of stricture at any point where an instrument can be applied.

Operation.—Select a metallic canula or catheter, open at both ends, of sufficient size to distend the urethra to its utmost extent, and pass it down to the obstruction; then arm securely a smaller canula with a morsel of caustic, so that it may project about two lines beyond the canula. Pass the smaller within the larger canula, carry it down to the stricture, retain it in contact with the obstruction for the time above directed, and, withdrawing it, inject oil, if caustic potash has been used, or salt and water, if the nitrate of silver has been applied, into the urethra through the larger canula, before the latter is withdrawn. After the caustic has been applied in this manner, at intervals of from three to eight days, according to the inflammation which may have been induced, forcible catheterism and dilatation, if judiciously performed, will generally perforate the obstruction; after which, lateral cauterization, occasionally performed with Lallemand's or some similar instrument, will diminish the risk of subsequent contraction.

Remarks.—The treatment of strictures of the urethra by any of the means just detailed is an operation requiring much judgment on the part of the operator, lest the force—either in dilatation, internal incision, or the introduction of the armed bougie—applied to a stricture through the instrument lead to a perforation of the walls of the urethra and the production of a false passage. But when the surgeon is guided by a correct knowledge of the structure concerned, as well as of the changes induced in the canal by disease, any of the plans just mentioned may be safely employed; the selection of one rather than another being mainly the result of the peculiarities of the case, or of individual experience and tact.

In estimating the value of any method of treatment in strictures of the

PLATE LI.

OPERATIONS PRACTICED ON THE URETHRA.

Fig. 1. Catheterism. The penis is held in the left hand between the thumb and forefinger, so as slightly to elongate the urethra, and prevent the formation of folds of the mucous membrane, while the second and third fingers push back the prepuce. The point of the catheter is about to enter the orifice of the urethra. *After Bourgery and Jacob.*

Fig. 2. A section of the pelvis and abdominal parietes, to show the relations of the parts and the position of Lallemand's porte-caustic, while passing through the prostate, in the operation of cauterization.

After Bourgery and Jacob.

Fig. 3. A similar section, showing the position of a catheter when being introduced into the bladder. The vertical line represents the plane of the symphysis pubis. The first position of the catheter, when its point has reached the membranous portion of the urethra, makes an arc of from 60° to 80°, as at 1. Depressing it yet more, about 25° or 30°, as at 2, elevates the point beneath the pubis, and carries it into the neck of the bladder. The circle 1, 2, 3 shows the line of motion of the mouth of the instrument; if the mouth is depressed more than the angle marked at 3, the instrument will drag on the suspensory ligament, and may injure the third lobe of the prostate and the bladder.

After Bourgery and Jacob.

Fig. 4. Puncture of the bladder through the urethra by means of the Stylet Catheter of Physick. 1. Course above the prostate, in consequence of the too early depression of the mouth of the instrument. 2. Puncture through the prostate near the natural line of the urethra. 3. Course below it.

After Bourgery and Jacob.

Fig. 5. A button-hole opening made in order to remove a stricture in the urethra. 1. A director passed down the urethra to the front of the stricture. 2. Another director introduced through the perineal puncture. 3. The bistoury enlarging the perineal incision. *After Bourgery and Jacob.*

Plate [illegible]

Fig. 1

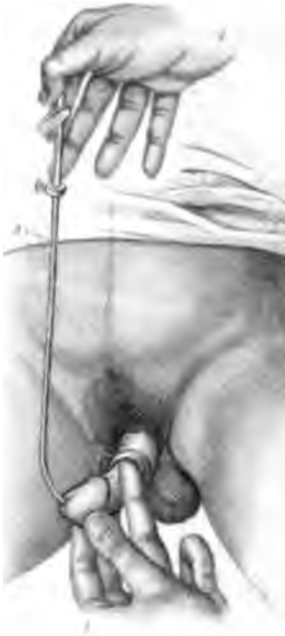


Fig. 2

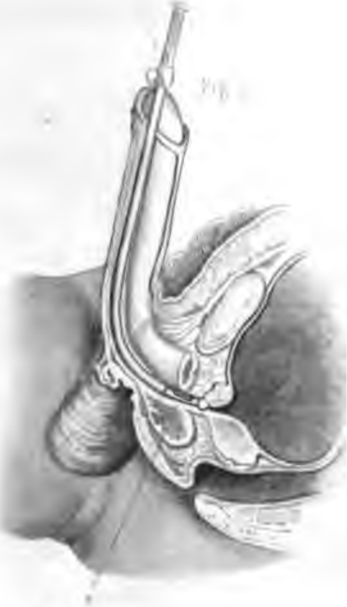


Fig. 5

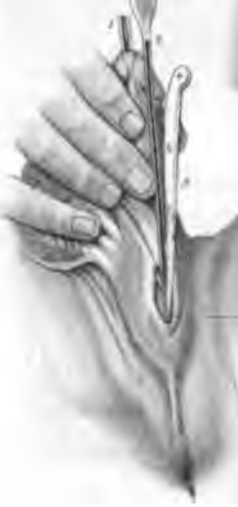


Fig. 3

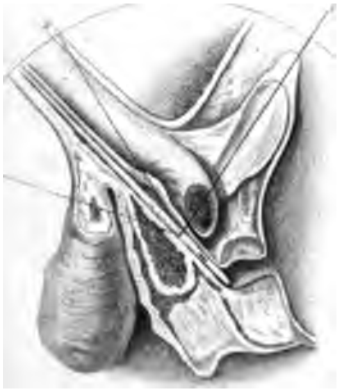
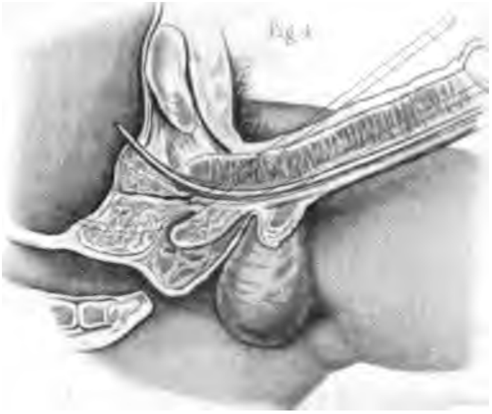


Fig. 4



urethra, it should, however, be recollected that a permanent stricture is a diminution of the urethra due to inflammatory thickening; that this thickening or obstruction often presents us with a species of inodular tissue, or organized lymph similar to it; and that, like ordinary cicatrices in the skin, the parts about it do not lose their contractile tendency for months. If, then, even in a moderately tight stricture, dilatation is resorted to, and forced catheterism practiced, a passage may be created and gradually enlarged under mechanical force, and yet so little change effected in the vital action of the part that, on the cessation of the dilating means, the stricture will be liable to return, as is daily seen in cases where the occasional use of the bougie is not pursued by the patient after leaving the hands of the surgeon. When, therefore, patients who, with a small and tight stricture, are usually barely able to urinate, but yet, when treated by dilatation, are enabled to void a full stream, and to receive readily a full-sized instrument, are about to leave their surgeon, they should not be allowed to return home under the idea that they are certainly cured; but should be made aware of the risk they will incur if they neglect the introduction of the bougie, as it is not uncommon to find them, in twelve months, more or less afflicted by a reappearance of many of their old symptoms. Dilatation, therefore, though very prompt and useful in many cases, is a plan of treatment liable to induce false security, as it merely palliates, but does not radically remove the complaint, unless persevered in for a long period.

When incisions are made through a stricture—either by internal scarification, as practiced with the stylet of Physick, or by the button-hole incision of the older surgeons, or by that which has lately been so highly lauded by Syme, of Edinburgh—there is also little change effected in the action of the part that can induce a hope of the permanent removal of the obstruction. As a means of insuring the prompt evacuation of the bladder, incisions are highly serviceable, and that resulting from the use of the stylet of Physick may do away with the necessity of tapping the bladder through the rectum; but alone these operations will do little toward curing a stricture, as the operation by internal or external incisions necessarily gives rise to new cicatrices, and these cicatrices ultimately increase the tendency to contraction. Although an incision is useful as a means of forming a communication with the bladder, I would yet caution the inexperienced operator against the omission of dilatation for a long period after the passage is apparently perfectly permeable by a cutting instrument, as the cicatrix resulting from the incision will almost invariably contract, and tend to reproduce the complaint.

The application of caustic is, I think, the best means of removing the diseased structure, and has many points worthy of deliberate and unprejudiced consideration. When a superficial eschar is formed, either by the rapid action of the potassa fusa, or by the slower effects of nitrate of silver, a certain amount of action is induced in the surrounding parts, which increases the activity of the tissue cells, and hastens a permanent cure. But even when the application of the caustic is not made with a view of creating an eschar, its effects will yet prove useful by modifying the action in the canal, stimulating the absorption of the fibrous deposit, allaying irritation, modifying vascular action, and inducing a return of healthy action. Enlargements of all kinds, even of bones, have often yielded to a similar stimulus, while the ulceration resulting from the separation of the eschar always tends to union by granulation rather than by actual contact, as is the case in incisions. The application of caustic requires, however, much care, as its action may extend to the sound parts unless carefully watched, and on this account its employment is objected to by many operators. By fully distending the sides of the urethra in the manner before mentioned, and applying the article as above directed, it is, however, difficult for the caustic to touch any other part than that which is directly in front of it, while the introduction of oil after the use of caustic potash, or of salt and water after that of the nitrate of silver, will effect such a change as will neutralize either article. In the treatment of old and dense strictures, I prefer the treatment by cauterization; in those which are small and recent, the employment of dilatation by means of those metallic bougies which, by having a broad handle, prevent any deviation of the point of the instrument, the solid bougies of all kinds being preferable to the flexible ones as dilating instruments; but in impervious strictures, or in a bad case of retention of urine, I resort to Chew's stylet, if it is possible to pass it with reasonable caution; and if not, I should cut into the bladder from the perineum, relying chiefly upon a knowledge of the anatomy of the structures concerned. Such an operation is, I well know, a very difficult one, and one in which no surgeon who was not an experienced anatomist would be likely to succeed; but, with correct anatomical and practical knowledge, it has been done, and could, of course, be repeated by others.

The treatment of stricture of the urethra, to be judiciously conducted, must be the result of a minute study of the anatomy of the parts, of the etiology and pathology of the complaint, as well as of an accurate diagnosis, lest the obstruction be supposed to be due to a different condition of the canal from that which actually exists. The subject of stricture of the urethra is one which has engaged special attention, and been most ably treated in monographs of considerable extent. A full account of the complaint must not, therefore, be sought in works which, like this, are of a general character, and I can now only append to this account a summary of the opinions of some of the more recent writers on the varied forms of treatment.

Dilatation, as being attended by the least inconvenience to the patient, is the treatment usually preferred by a majority of practitioners, though a large number of experienced surgeons regard it with distrust, and look upon "a cure by dilatation" as a very temporary one, the disease often returning soon after the cessation of the treatment. Among the latter is Henry Thompson, of London, who, in a work* on strictures of the urethra, which attained the Jacksonian prize for the year 1852 from the College of Surgeons, remarks in relation to dilatation as a means of treatment: "That although there are few cases in which, with care and perseverance, an instrument cannot be passed through the stricture, and prove the most safe, efficient, and generally applicable of all the means of treatment, there are yet some in which its effects are so temporary that its claim to be regarded as a cure must be disputed. The contraction often reappears, and that so rapidly that, in order to maintain a canal sufficiently patent for the performance of its functions, an instrument must be passed every other day or oftener, and the patient be thus submitted to perpetual treatment."

The same surgeon, speaking of the use of caustics, also expresses the opinion that the nitrate of silver is useful in a very limited number of cases; that neither it nor the caustic potash should be used as an escharotic; but that the potassa, when applied in very minute quantities, "possesses a certain power to loosen and dissolve the tough fibrous tissues of some strictures."†

In summing up the treatment of strictures, Thompson thus concludes:‡

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* The Pathology and Treatment of Strictures of the Urethra, by Henry Thompson, p. 205. London, 1854.

† Op. cit., 220.

‡ Ibid., p. 284.

"That dilatation has been found successful in the great majority of cases, but that it is certainly inefficient for the cure of some old and extensive strictures, as well as for some which are accompanied by a highly irritable condition of the urethra; that cauterization is a useful adjuvant to dilatation, especially where much irritability exists, though wholly inapplicable to the removal of old and extensive contractions; and that the internal division of strictures (incision) is particularly suited to those last-named cases when situated in the anterior or middle part of the urethra."

Guthrie* gives as the result of his experience that "a hard and elastic, or intractable stricture, is never permanently cured by dilatation, or by the application of caustic, although it may be relieved by the regular periodical use of a dilating instrument; and that the strictures generally deemed most difficult to cure, may be best removed by cutting through them," though he also expresses the opinion that the division of an old, hardened, or elastic stricture through the perineum will not usually be followed by a permanent cure unless dilatation is subsequently continued, and he therefore prefers the internal incision, or the division of a stricture by a stylet, especially in old and fat patients, as it creates less constitutional disturbance.

Many other writers might be quoted who object to all incisions; but as their statements would only show the diversity of opinion that exists in regard to the best plan of treatment, I shall omit them.

I have now only to repeat my individual preference for the following plans: First, to try dilatation, and continue it in permeable strictures; second, to render strictures which are very dense, or nearly impermeable, more easy of dilatation by the therapeutical or alterative effects of either caustic potash or the nitrate of silver; and, third, to attempt to cut through all impermeable strictures by the stylet, if they are seated anterior to the membranous portion of the canal, or by the perineal section, when seated farther back or in the membranous structure.

SECTION V.

PUNCTURE OF THE BLADDER.

When, in cases of stricture, it is found impossible to evacuate the contents of the bladder through the urethra, or by the urethral section, or the surgeon is unwilling to expose his patient to the risks of a perineal operation—cases which, in truth, are very rare in the hands of an experienced surgeon—the contents may be evacuated either by puncturing it through the perineum or rectum, or through the abdominal parietes above the pubis.

I. **Puncture through the Perineum.**—Place the patient in the position of lithotomy, and let an assistant hold up the scrotum and press upon the bladder above the pubis. Then, while standing in front of the perineum, place the left forefinger on the left side of the raphe, half an inch in front of the anus, and between the bulb and the ramus of the ischium, so as to render the perineum tense, and, with a straight trocar and canula, at least seven inches long, puncture the integuments. Then, passing the left forefinger into the rectum, so as to preserve the bowel untouched, push the trocar toward the bladder, so that its point may reach the base of this viscus near its neck, or behind the prostate gland, by passing through the skin, fascia, fat, and anterior edge of the levator ani muscle. When the want of resistance, and the greater mobility of the point of the trocar indicate that the instrument has entered the bladder, withdraw the finger from the rectum and the trocar from its canula, when, after evacuating the urine, the canula may be corked and fastened in position by tapes, which should be attached to a double T or split perineal bandage. In very urgent cases the bladder may be evacuated by puncturing it through the perineum with a lancet, as was once done by Sir A. Cooper, and also by Jones, of Philadelphia.*

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* Lancet, June, 1851.

II. **Puncture through the Rectum.**—As the bladder, when distended, encroaches very much upon the rectum, forming there a tumor which may be felt from the gut, and as there is no structure of consequence on the median line of the bladder immediately behind its neck, the urine may be evacuated through the rectum in the following manner:—

Operation.—Place the patient in the position for lithotomy, and pass the left forefinger, well oiled, into the rectum, and it will readily reach the prostate gland, immediately above and behind which it will feel the distended bladder lying nearly in contact with the rectum, a little cellular tissue alone intervening *in the median line.* Then, with the curved trocar and canula sold by the cutlers for this purpose, the puncture may be made as follows: Withdraw the trocar within the end of the canula, and passing it along the forefinger first introduced into the rectum, bring its end to the protruding portion of the bladder, and then thrusting the trocar forward, puncture the anterior coats of the rectum, the intervening cellular tissue, and the posterior coats of the bladder. On withdrawing the trocar, hold a vessel to receive the urine, and after evacuating it, plug up the canula and fasten it in its position by means of tapes attached to a T-bandage, as before described.

After-Treatment.—The patient being kept in the horizontal position, the canula should be accurately retained at each stool, and if required to be worn longer than three days, changed by slipping a small catheter through it into the bladder, and this catheter changed by slipping another or the canula again over it. When the urethra can subsequently be rendered pervious, a catheter should be kept in the bladder through the urethra, in order to favor the healing of the rectal fistula which is apt to supervene.

III. **Puncture above the Pubis.**—The patient being placed on his back, and the hair shaved off, make an incision, an inch and a half long, through the skin, fascia, linea, alba, and between the recti muscles, so as to expose the fascia behind the muscles and immediately over the distended viscus, the peritoneum in these cases being reflected from the bladder to the abdominal parietes in such a manner as to prevent its being involved in the operation. Then puncture the bladder with the curved trocar and canula used for the puncture through the rectum, or have one made with a curvature of a segment of a circle seven inches in diameter, so as to adapt it more readily to the curve behind the pubes. After evacuating the urine, fasten the canula by tapes to a T bandage, and pass an elastic catheter through the canula, so as to prevent its end irritating the coats of the bladder. If the instrument is worn several days, it should be withdrawn while the catheter remains in order to cleanse it, and then replaced by slipping it over the catheter as a director.

Remarks.—As all these operations are liable to be followed by death or serious inconvenience, they should never be resorted to without a consultation, if it can be had, and until every means has been tried to overcome the obstruction in the urethra. The advantages possessed by one of them over the others is shown by the following table of Mondiere, given in the *Revue Médicale*, April, 1841, and quoted by Gross* :—

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* Dorsey's Surgery, vol. ii. p. 173.

	Cases.	Cured.	Fistula.	Infiltration.	Death.
Perineal	9	6	1	0	1
Recto-vesical	28	19	3	3	2
Supra-pubic	55	49	0	0	6
	92	74	4	3	9

The recto-vesical operation is thus shown to be the least fatal, but the most frequently followed by fistula and infiltration, while the perineal and supra-pubic operations have each been followed by one death in nine operations. The proportion of deaths after all the operations is, however, remarkably small in this table, and much less than has generally been supposed to be the case. The operation of puncturing the bladder must, however, be very rarely necessary, as I have never, during a period of nearly thirty years, seen a case requiring it or a patient on whom it had been performed.

IV. **Puncture of the Bladder in the Female.**—The straightness and short extent of the female urethra render the operation of catheterism, as hereafter detailed, usually an easy one. Should it, however, be ever requisite, the puncture of the female bladder may be made by introducing a trocar and canula through the vagina, and healing the fistula subsequently left by touching it with the nitrate of silver.

§ 1.—Fistula in Perineo.

Pathology.—When the existence of a deep-seated stricture has led to a dilatation and rupture of the urethra behind it, the following effects may be noted: The urine, when expelled from the bladder, escapes into the surrounding areolar tissue, and either creates such violent inflammation as results in gangrene, or, in more favorable cases, leads to the formation of an abscess, which, breaking outwardly, leaves an ulcerated opening, through which most or all of the urinary secretion is subsequently voided. This opening constitutes a **Perineal Fistula,** and continues because the flow of urine prevents such adhesive action as would heal it. Sometimes the fistula communicates directly with the urethra, though most frequently the hardening, contraction, and adhesions of the surrounding parts give it a more winding course, and render it difficult to trace it with a probe. When a perineal fistula has existed for a few weeks, the urethra in front of the stricture is often disposed to contract and close up, so that a channel, which was previously quite pervious, not unfrequently becomes directly the reverse, rendering it impossible to enter the bladder by the usual route, and requiring high operative skill in order to restore its permeability.

Operation for Perineal Fistula.—When a perineal fistula is so situated as to permit the introduction of a director into the bladder, and of a probe into the urethra in front of the stricture—Plate LI. Fig. 5—the formation of the button-hole opening, before referred to, will frequently prove sufficient to restore the continuity of the canal, especially if the subsequent use of the catheter is persevered in until the fistula has healed. But when there is a considerable distance between the bladder and the permeable portion of the urethra, the indurated perineum will sometimes defy all attempts to trace the course of the fistulous canal into the bladder, and the surgeon will be compelled to open the perineum, as in the operation of lithotomy, and divide all the portion which intervenes between the neck of the bladder and the spongy portion of the urethra. As this operation is one in which anatomical knowledge is of the utmost importance, the incisions being regulated entirely by the judgment of the operator, it is usually regarded as one of the most difficult in surgery, and as surpassing that of lithotomy. In many instances, surgeons have preferred trying other means, and, when these failed, have left the result to nature; but, as a cure can be accomplished, it is the duty of every one to acquire such experience as is essential to its success. In three instances, though satisfied of its difficulty, I have been pleased with the result, all the patients being cured both of the fistula and stricture. As characteristic of this operation, I cite the following method, as described by Wm. E. Horner, of Philadelphia,* and based upon his own dissections of the parts concerned.

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* Diseases of the Urinary Organs, p. 315, from Am. Journ. Med. Sciences, vol. iii. N. S. p. 495.

Operation of Horner.—*Anatomy.*—By repeated observation, Horner has found that, from the top of the symphysis pubis to the anterior end of the membranous part of the urethra, the distance is two and three-quarter inches; to the posterior end of the bulb of the urethra, three and three-quarter inches; and to the urethral opening in the triangular ligament, three inches. These measurements should be firmly impressed on the mind, lest in the subsequent stages of the operation the surgeon be unable to recognize his position in the perineum. Then confining the patient's hands and feet together, as in the lateral operation for stone, commence the perineal incision on the raphe, just at the posterior plane of the scrotum—say, by measurement, two inches and a half below the superior face of the symphysis pubis—and carry it back three inches to a point exactly in the mid-space between the tuber ischii and the anus, on the left of the patient. Having, by a series of careful incisions, separated the corpus spongiosum, covered by the accelerator, from the crus penis, expose fairly that side of the triangular ligament of the urethra, upon the anterior surface of which, immediately under the union of the corpora cavernosa, lies the membranous part of the urethra. By measurement, the membranous part of the urethra will be found precisely two and a half or three-quarter inches below the top of the pubis, or half an inch below the inferior margin of the inter-pubic ligament.

When the operation is thus far done, pass a staff along the urethra; and, as the stricture is generally behind the scrotum, just in or near the membranous part of the urethra divide the stricture on the point of the staff, cutting freely along the membranous part of the urethra, as in lithotomy. But let this division be done upon the upper middle line, instead of the lower or lateral one, as the eventual healing is more favored by the opening being closed by parts in direct contact. If the staff cannot be used in the way indicated, open the membranous part of the urethra just where it joins the corpus spongiosum, and divide the stricture from behind forward. The collapsed state of the membranous part makes its division obscure and difficult; care and skill will, however, surmount the obstacle. If the membrane be really opened, a common probe may be passed into the bladder from the opening. Upon this a small tin director should be passed into the bladder, and the probe then withdrawn. Upon this tin director, which is of semi-cylindrical shape, another, but larger director, should be passed into the bladder, and the first director withdrawn; upon the second director, a third is to be passed after the same rule; upon the third, a fourth. The route to the bladder is now so well opened that a lead catheter of large size should next be conducted along the urethra from the glans penis, through the spot where the stricture was, into the tin director, and fairly lodged in the bladder.

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* Horner, in MS.

It is best to keep the perineal incision open for a few days, so as to prevent the urine from getting into the old fistulæ; this may be done by dressing it with lint down to the mucous membrane of the urethra. But to make this more certain, it would be better to draw a loop of silk or of thin gum-elastic over the catheter in the urethra, and let the other end project beyond the lips of the wound. Another mode of accomplishing the same is by a second catheter introduced through the perineum into the bladder; but this makes the neck of the bladder rather uneasy, and if it be resorted to, the first catheter should be small and also flexible.

The catheter becomes obstructed in a few days, and must be cleansed or renewed in every case; but before the catheter is withdrawn, pass a director through the perineum into the bladder. This director is to be used as a guide for the reintroduction of the catheter, until the urethra is so much dilated and repaired that the route through it is perfectly easy. A *leaden* catheter is the best and the least irritating.

§ 2.—Hypospadias and Epispadias.

An imperfect condition of the urethra is occasionally found as the result of a congenital defect, in which the canal terminates or opens by a slit upon some point between the scrotum and head of the penis. When the opening is upon the inferior portion of the penis, it takes the name of **Hypospadias,** but when situated on the dorsum, it is called **Epispadias.**

Hypospadias, being the more common of the two, may be taken as the type of this deficiency.

Hypospadias may be found at any point, but it is especially seen at the fossa navicularis, near the middle of the penis, near its root, or between the penis and the scrotum.

Operation.—When the opening is near the glans, and the anterior portion of the canal is impervious, puncture the point of the glans with a bistoury, and push in a small trocar and canula until the perfect urethra is reached, taking care not to push the point of the instrument either toward the dorsum or under surface of the organ. After creating the canal, keep a catheter constantly in it until the parts have healed. The contraction consequent on cicatrization is, however, apt to cause a considerable diminution in the size of the new urethra.

When the opening is seated near the middle of the penis, and the urethra is patulous to near the fossa navicularis, the trocar may be introduced into the orifice and carried forward to the point of the glans.

Sometimes the defect has consisted in a mere fissure, around which the corpus spongiosum was deficient. Although this is almost a hopeless case, the surgeon may deem it advisable to attempt a plastic operation, freshen the sides of the fissure, and unite the skin of the part over the catheter.

The rarity of hypospadias in such a position and to such an extent as presents much chance of success renders it difficult to assign any value to the modes of operating that have been described, few of them having accomplished perfect cures. In a little patient of eighteen months, who had an opening near the middle of the penis, but in whom the urethra was otherwise perfect, I have, however, succeeded in closing the fissure by freshening the edges and uniting them by the hare-lip suture; and Mettauer, of Virginia, has also reported a case of rare deformity of the penis, which was relieved by an operation. As his account also contains an excellent description of some of the usual forms of this defect, the reader will derive much valuable information by referring to it.*

SECTION VI.

AFFECTIONS OF THE SPERMATIC CORD.

Varicocele—*Varix*, a distended vein, and κηλη, a tumor—or **Circocele**—κιρςος, a varix, and κηλη, a tumor—are terms often indiscriminately employed by writers to designate a varicose enlargement of the spermatic veins, varicocele being that mostly used.

Etiology.—The causes of varicocele are varied, being any that will induce congestion of the veins of the cord by interrupting the circulation through them, such as tight waistbands, or other ligatures around the abdomen, constipation, and occasionally extreme continence. It may also follow the improper application of a hernial truss.

Varicocele most frequently affects the veins of the left testis, a result—as explained by Brinton, of Philadelphia—"of the existence of a very perfect valve, that he discovered at the entrance of the right spermatic vein, into the vena cava, which thus supports the column of blood on the right testis, while there is no valve at the termination of the left spermatic in the emulgent vein."

Symptoms.—Varicocele is generally attended by a sense of fullness in the scrotum, with a dull, heavy pain in the back, as well as in the line of the cord, when the patient stands some time, but which is relieved by lying down, or by holding up the testis. The patient is also often depressed in spirits, thinks constantly of copulation, is fearful of losing his virile powers, and notices especially the diminished size of the testicle on the affected side, as well as the relaxed condition of the scrotum. On seizing the scrotum and cord between the thumb and forefinger, a collection of enlarged vessels can be felt, which give a sensation that has been compared to that caused by a number of earth-worms in a bladder. Hydrocele sometimes, though rarely, supervenes; while, in rare cases, the testis also becomes atrophied, though seldom permanently so.

Diagnosis.—Varicocele is a very common affection which is not unfrequently confounded with omental hernia, as it moves when the patient coughs. But a diagnosis may be made by placing the patient in the horizontal position, when both a reducible hernia and a varicocele will disappear. If a finger is now firmly pressed on the external abdominal ring, and the patient stands up, the hernia will be prevented from escaping from the abdomen, while the veins will gradually fill, and reproduce the varicocele, notwithstanding the pressure.

Prognosis.—The prognosis of varicocele is favorable. When due to engorgement of the testis, the stimulus of occasional sexual intercourse will usually relieve it; while, if the enlarged veins are operated on, a cure may be obtained, and the testicle resume its natural size and function. Its existence is occasionally a source of trouble by inducing relaxation of the scrotum and chafing of the latter against the thigh in long marches; hence, when very large, it is regarded as unsoundness in recruits.

Treatment.—The cure of varicocele may often be accomplished without an operation, though frequently this is necessary. When dependent on constriction of the abdomen, or constipation, or on a badly applied truss, or extreme continence, the removal of the cause will, if persevered in, suffice for the cure. Advantage, under these circumstances, will also be derived from the use of a suspensory bandage,* and from bathing the scrotum and loins, night and morning, in a basin of cold water. But if the enlarged veins have existed for a long time, and the testis is atrophied, an operation for their obliteration will be demanded, such as ligation of the veins or compression.

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* Am. Journ. of Med. Sciences, vol. i. N. S. p. 43, 1842.

In all the operations upon the veins of the cord, it is important that the surgeon should first separate the vas deferens and spermatic artery from the bundle of veins. This may be readily done by gently compressing the cord between the thumb and fingers of one hand, and causing the vessels to slip laterally, when the vas deferens, which may be told by its cartilaginous consistence, the artery being known by its pulsation, will readily pass to the inner side of the cord. The veins being then rendered distinct by the patient standing up, any of the following operative processes may be selected.

Ordinary Operation of Ligation of the Spermatic Veins.—The patient either sitting in a chair, standing, or lying down, as most convenient, with the scrotum entirely divested of hair, grasp it from behind with the left hand, and make a vertical incision, nearly an inch long, over the anterior part of the tumor, down to the enlarged veins. Then carefully isolating these from the vas deferens, artery, and nerves, by a few touches of the point of a scalpel, pass a short, thick, straight needle underneath two or three of the larger trunks, and, winding around it a stout thread, either elliptically or in the form of the figure 8, draw it with great firmness, so as to indent the coats of the vessel, and stop the circulation, after which the wound may be closed by adhesive plaster, or a twisted suture. The patient being now put to bed, and the scrotum supported, he should be kept on light diet. At the end of twenty-four hours, when the blood in the veins is sufficiently coagulated, pass a sharp-pointed and narrow bistoury underneath the veins, with its back to the needle, and divide them. Should symptoms of inflammation arise about the parts, cold lead-water or the cold water-dressing may be demanded. In five or six days, the patient may sit up, and in a few more will be permitted to walk about.

This operation, which is that of Celsus, has always been found adequate to the cure of the complaint.

Operation of Jno. Watson, of New York.—The varicose veins being soft and swollen in a lump as large as a hen's egg, the pain and uneasiness led the patient to seek relief by an operation, which was performed as follows: The whole of the free integuments that could be embraced without much stretching, being included in the blades of a very long and slender forceps, which passed over the cord, and obliquely down to the lower part of the scrotum on the opposite side, the included part was removed by one sweep of the bistoury, leaving a wound which gaped so much as to expose both testicles, covered only by the tunica vaginalis. The external pudic artery, near the upper angle of the wound, was the only vessel that required the ligature, and five or six stitches of the interrupted suture were necessary to coaptate the integuments over the cord, and so on, below the testes. The patient suffered but little, was dressed with the water-dressing, confined to bed for several days, and, before the end of the month, had the wound perfectly healed, and the varicocele cured.

This operation, though a modification of Sir Astley Cooper's, acts rather by drawing the cord laterally than by elevating the testes, as was the object

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* Vol. i. page 128.

PLATE LII.

OPERATIONS PRACTICED ON THE TESTICLE AND CORD.

Fig. 1. Ligation of the Spermatic Artery. 1. The director passed beneath the artery. *After Bernard and Huette.*

Fig. 2. Velpeau's operation for Varicocele. 1. The pin as passed behind the vessels. 2. The figure of 8 ligature thrown around it. *After Bernard and Huette.*

Fig. 3. Ricord's operation for Varicocele. 1. The first loop of a double ligature carried between the veins and the skin. *After Bernard and Huette.*

Fig. 4. View of the Veins and Ligatures before the latter are drawn tight. 1. The enlarged veins. 2. The vas deferens. 3. The posterior ligature. 4. The anterior. *After Bernard and Huette.*

Fig. 5. A view of the Knot formed by drawing on the ends of each Ligature, after they have been passed through the opposite loop and are about to constrict the veins. *After Bernard and Huette.*

Fig. 6. Operation of Vidal de Cassis for Varicocele. 1, 1. The enlarged veins. 2, 3. The two silver wires passed in front and behind them, so as to compress the vessels when they are twisted. 4. The vas deferens. *After Bernard and Huette.*

Fig. 7. A view of the arrangement of the wires. The larger one remaining firm, the smaller twists around and compresses the vessels upon it. *After Bernard and Huette.*

Fig. 8. The Veins as constricted, shortened, and rolled up by the twisting of the silver wires. *After Bernard and Huette.*

Fig, 9. Breschet's operation. 1, 1. The compressors. *After Bernard and Huette.*

Fig. 10. The operation of Castration. 1. The scrotum drawn back to favor the enucleation and dissection of the testicle. *After Bernard and Huette.*

Fig. 11. A side view of the operation of Tapping in Hydrocele. 1. Position of the left hand as it compresses the sac. 2. The right hand holding the trocar and canula. *After Bernard and Huette.*

Fig. 1.

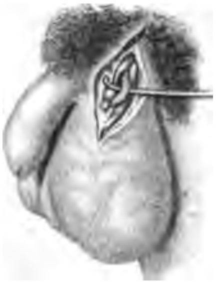


Fig. 3.

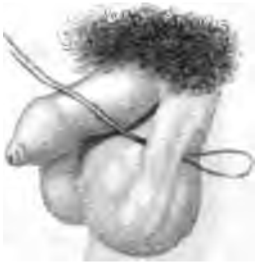


Fig. 2.

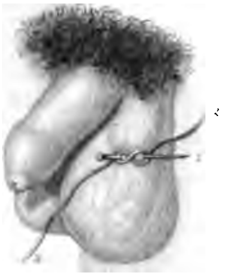


Fig. 4.

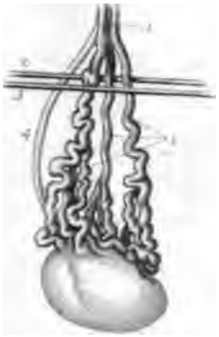


Fig. 5.

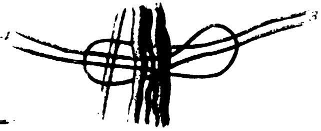


Fig. 7.

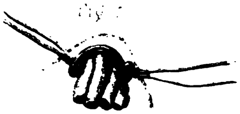


Fig. 8.

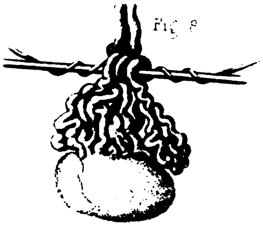


Fig. 6.

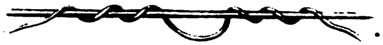


Fig. 9.

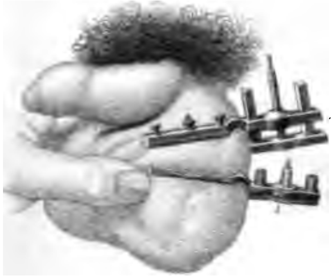


Fig. 10.

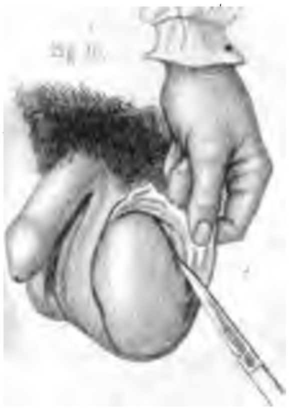
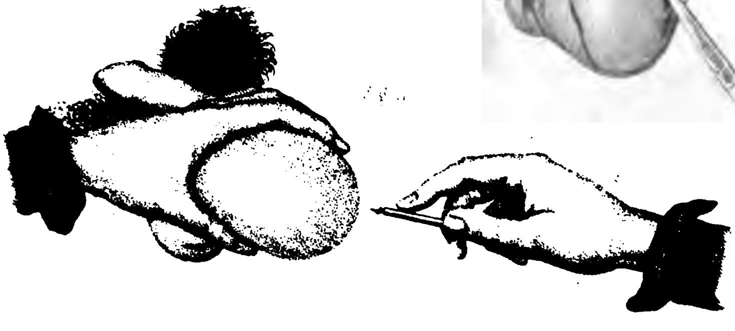


Fig. 11.



of Cooper's operation. As it compresses the veins in their long diameter, it soon diminishes their calibre.

Operation of Velpeau.—After picking up the enlarged veins between the thumb and fingers, a pin is passed through the skin behind the veins, and surrounded by a figure of 8 suture, so that the scrotum and the veins may be compressed by the ligature upon the pin, Plate LII. Fig. 2. After two or three days have elapsed, and there is evidence of inflammation, this pin may be removed, as in the ordinary hare-lip suture. But, as the compression of the integuments even for this period seemed to be liable to induce erysipelatous inflammation, Velpeau subsequently modified the operation by passing a double ligature in front of the veins beneath the skin, and, placing the pin behind the vessel, slipped the loop of the ligature over one end of the pin, and tied its two ends around it so as to compress the veins directly upon the pin.

Operation of Ricord.—After isolating the veins, Ricord operates as follows: Two needles being prepared, each threaded with a double ligature, the surgeon passes one of them *behind* the veins, so that the loop of the ligature projects a little outside of the scrotum, Plate LII. Fig. 3, and removes the needle. Then, passing the point of the second needle from the opposite side of the scrotum, but through the same puncture as that made by the exit of the first needle, he carries the second ligature in front of the veins, and thus forms two loops, one on each side of the scrotum. On passing the free ends of each ligature through the opposite loop, and drawing upon them, the vessels will be constricted by the approximation of the loops beneath the skin, Plate LII. Figs. 4, 5, the tightness of the compression by each ligature being preserved by tying its ends upon a small plate or pledget outside the skin.* After the constriction has been thus practiced for forty-eight hours, untie the ends of the ligature from over the pledgets, and, pushing upon the threads, loosen the loops, or introduce fine-pointed forceps, and draw them out, or attach a single and colored thread to the centre of each loop before drawing it into the wound.

Operation of Vidal de Cassis.—This surgeon combines the subcutaneous ligature of the veins with diminution of their length, so as to prevent the subsequent return of the circulation, in the following manner: A silver thread being passed with a needle behind the cord, another larger wire is made to pass through the same opening in front of it, Plate LII. Fig. 6, and the veins being thus placed between the two wires, beneath the skin, their extremities are twisted, until by the torsion they are brought closely together and strangulate the veins. By continuing the torsion, the metallic cord in its rotation draws in the parts comprised between the wires, so that the veins are rolled around them until, as the twist is continued, the testicle itself is raised, Plate LII. Fig. 7, its ascent being facilitated by the relaxed condition of the parts.

Finally, the two ends of the metallic cord are knotted on a pledget upon the skin, and, a director being passed beneath the knot, the whole is twisted more and more, from day to day, until the wires cut through the skin and veins.† The advantages claimed for this mode of operating are a diminution in the length of the spermatic cord, and the section of the veins at the several points where they have been twisted.

Operation of Breschet.—By means of a pair of clamps or compressors, the circulation was interrupted, and sloughing of the vessels induced by the following operation:—

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* Op cit.

† Dict. de Méd., tome xxx. p. 560.

Pick up a fold of the scrotum, so as to include the enlarged veins, and inclose it in a branch of the forceps, Plate LII. Fig. 9, applying another pair in a similar manner, a short distance above the first. By tightening the screws from day to day, the constriction is sufficiently increased to result in sloughing, after which the ulcer is healed by the usual means.

Remarks.—The danger arising from operating upon varices in the limbs does not appear to follow the operation performed for the relief of varicocele, while the difference in the anatomical relations of the spermatic veins, and the absence of the free anastomoses that exist between the different veins of the extremities, usually render the operation much more successful in this region than it is in the veins of the leg.

Compression, as advised by Breschet, has resulted in death* in several instances, and is now seldom or never resorted to. Indeed, it may be useful to the young surgeon to offer a word of caution in regard to the performance of any operation for varicocele, until cold astringent washes, the constant use of a suspensory bandage, and the exercise of the function of the testicle have been fully tried, as these means usually suffice for the cure of the complaint.

SECTION VII.

OPERATIONS ON THE SCROTUM.

In cases of tumors of the encysted variety, or in hypertrophy of the scrotum, the same principle should be carried out as would be applicable to similar tumors elsewhere. Hypertrophy, or elephantiasis of the scrotum, has sometimes required very extended dissections, although limited generally to the scrotum. In a case reported in 1837,† by Picton, of New Orleans, the weight of the tumor was fifty-three pounds, while it reached nearly to the patient's feet. In two months the man was cured, and the tumor is now in the Wistar and Horner Pathological Museum of the University of Pennsylvania, at Philadelphia.

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* Philad. Med. Examiner, vol. iii. 1840.

† See Curling on Testis, Philad. edit., p. 537.

CHAPTER II.

AFFECTIONS OF THE TESTICLE.

THE disorders of the testis not previously described are such as result in an effusion of water or of blood into its serous coat, these being named respectively **Hydrocele** and **Hæmatocele.**

SECTION I.

HYDROCELE.

Hydrocele is a collection of serous fluid within the cavity of the tunica vaginalis testis, the term being derived from two Greek words—*ὕδωρ*, water, and *κηλη*, a tumor—signifying a watery tumor.

Anatomical Relations of the Tunica Vaginalis.—The tunica vaginalis testis, as mentioned in connection with the subject of hernia, is that portion of the peritoneum which was originally pushed before the testicle in its descent from the abdomen into the scrotum. In its new position this portion forms, therefore, a double envelope for the testicle, and its connection with the abdomen having been obliterated, it constitutes a closed sac, as is the case with other serous membranes. Like these, the tunica vaginalis testis also secretes a certain amount of halitus or moisture in the natural condition of the parts, which serves to lubricate and facilitate the motion of the testicle; without which the delicate structure of the testicle would be exposed to contusion whenever the patient crossed his thighs.

Etiology.—Various disorders may cause the natural secretion of the tunica vaginalis testis to become inordinate in quantity, and so create a hydrocele. Thus, inflammatory action may produce it, as is the case in hydrocele which ensues upon epididymitis, orchitis, or blows. Or it may occur suddenly in consequence of the congestion created by great muscular exertion, as in a patient under my care, in whom a very considerable hydrocele resulted in the course of half an hour after he had lifted a barrel of flour from the ground into a wagon.* Other cases are also on record, and should be borne in mind, lest a tumor from hydrocele, of sudden occurrence, be confounded with hernia. Generally, however, the causes of hydrocele may be stated to be those which are likely to develop chronic inflammatory action in a serous membrane.

Symptoms.—When fluid accumulates in the tunica viginalis testis, a tumor is formed, which, beginning at the bottom of the scrotum, gradually rises upward, until it may extend all along the cord, as high as the external abdominal ring; or the tumor may form along the course of the cord, and present the symptoms hereafter detailed.

When the effusion is limited to the proper tunica vaginalis testis, the tumor begins below, and gradually ascends, becoming larger and larger, though it does not enter the external abdominal ring, and unless it is complicated with hydrocele of the cord, produces no thickening of the cord itself. To the touch, hydrocele presents generally a sense of fluctuation, such as might be expected from any collection of fluid. But if the parts are excessively distended, or if, as sometimes happens, the tunica vaginalis has become dense, and more or less indurated or ossified, the sense of fluctuation may be partially or entirely absent; a fact which should be borne in mind, in order to prevent the confounding of such a case of hydrocele with other tumors of the testis. As a general rule, then, the symptoms of a hydrocele may be stated to be: 1. The formation of a tumor at the bottom of the scrotum. 2. The sense of fluctuation. 3. The translucency of the tumor. The last is the most positive sign, and may be employed to facilitate the diagnosis by the following arrangements: Let the room be darkened, and the patient seated upon a table, chair, or edge of the bed; then grasping the tumor in the hand, so as to force the fluid well down into the scrotum, hold a candle or a lamp upon the opposite side from the eye of the surgeon, when, if the tumor is a hydrocele, it will appear sufficiently translucent to enable the surgeon to recognize the position of the testicle as a dark mass, this being generally of the normal size, and in the posterior part of the scrotum. This test, however, is not an infallible one; as it may happen that the tunica vaginalis testis is thickened by disease, or the fluid distending it may be rendered opaque, either by the presence of blood in consequence of the rupture of some small blood-vessel, or from some other cause. In this case, the light will not be transmitted. As a general rule, however, the fluid of a hydrocele is of a pale-straw color, and the test of transmitted light is an exceedingly satisfactory one, showing not only the character of the fluid, but also the position of the testicle.

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* See Am. Journ. of Med. Sci., vol. xiii. N. S. p. 85, 1847.

Diagnosis.—It has been already mentioned that hydrocele may be confounded with scrotal hernia. The latter, however, begins at the external abdominal and *descends*, creating, moreover, a tumor to which a certain amount of succussion is communicated when the patient coughs, which is not the case with hydrocele, except in congenital hydrocele, in which, as was stated in connection with the subject of hernia, the communication between the peritoneum and the tunica vaginalis testis is not closed, and in which, therefore, the same succussion is perceptible when the patient coughs. If the hernia is reducible, its reduction by the taxis will dispel any doubts that may exist as to the nature of the case.

Hæmatocele, or a collection of blood within the scrotum, as hereafter described, will, at times, present the symptom of fluctuation which might be confounded with that of hydrocele. Generally, however, a diagnosis can be made by means of transmitted light. The fluctuation of hæmatocele, moreover, is usually much less distinct than that of hydrocele; but obscure cases will sometimes present themselves, in which it may be necessary to resort to an acupuncture needle, or to a small trocar and canula, by means of which a diagnosis may certainly be made, for, if the tumor is a hæmatocele, nothing but blood will escape from the puncture. Should it, however, be a hydrocele, the escape of the characteristic straw-colored fluid will at once reveal the nature of the case. Should it happen, as is sometimes the case, that a hernia is present, and is punctured with the little trocar or needle, the trifling wound thus made will generally heal without doing any serious mischief; but such an event should if possible be avoided.

The tumor formed by a hydrocele, if of any extent, is usually smooth, the distention having completely obliterated all the wrinkles of the scrotum, though this condition is also produced by other tumors as well as by hydrocele. A hydrocele is often of such size as to bury the penis completely, the position of the organ being only marked by an irregular depression, similar to that made by the umbilicus.

Prognosis.—The prognosis of hydrocele will depend upon circumstances. As it is generally possible to evacuate the fluid which distends the tunica vaginalis, the prognosis, in most cases, will be favorable as regards the result of the operation. But, unless some means be resorted to for producing inflammatory action, and thus gluing together the walls of the cavity in which the accumulation of fluid has taken place, after the manner hereafter directed in the operations for a radical cure, a fresh accumulation will occur, and all the inconvenience of the disease be reproduced. The prognosis of the operations for the radical cure is generally favorable; the dangers being either of the inflammation going too far and producing sloughing, or that it shall not go far enough, when a reproduction of the disease is apt to follow. If the disease be not treated at all, yet is its prognosis favorable so far as the mere question of mortality is concerned; though it may produce inconvenience from its size, and often interfere materially with the proper performance of the generative functions.

Treatment.—The treatment of hydrocele may be either palliative or radical.

The palliative treatment consists in the puncture of the tumor with a bistoury, a trocar and canula, or some similar instrument, and the evacuation of its contents. Such a puncture should be boldly made in the direction hereafter stated, so as to penetrate the tunica vaginalis testis, and not permit the instrument to slip into the areolar tissue between the skin and the tunica vaginalis. After the evacuation of the liquid, the patient will at once be enabled, with the aid of a suspensory bandage, to resume his ordinary avocations; and, in some few cases, may go a year or even eighteen months before another tapping will be required, though usually the interval is only a few weeks. The radical cure may be accomplished by any of the following operations:—

Ordinary Operation.—After being satisfied of the position of the testicle and the presence of the fluid, the patient should be made to sit upon the edge of a bed, table, or chair, with his thighs widely separated, or else permitted to lie on his back in bed with the limbs in the same position. The surgeon, then seizing the tumor with his left hand, and compressing it so as to render the scrotum perfectly tense, Plate LII. Fig. 11, takes the trocar and canula and punctures the swelling in front, but a little below its middle, directing the point of the instrument upward and obliquely backward, in order to avoid the testicle, which is generally situated behind and below, though occasionally it is in front or at the top of the swelling, where its position may be readily told by the sensibility shown on compression of the part. As soon as the free motion of the point of the instrument shows that it is within the cavity of the tunica vaginalis, the assistant should hold the empty bowl, and the surgeon, retaining the canula in his left hand, should withdraw the trocar with the right, and allow the liquid to escape. After the evacuation is completed, the nozzle of the syringe—charged with an injecting fluid of a stimulating character, the best of which is Lugol's solution of iodine, a half ounce of which is usually sufficient—should be adapted to the canula, and the liquid injected by an assistant, while the surgeon, retaining the end of the canula in its position, takes especial care that the liquid is not thrown into the connective tissue of the scrotum instead of the vaginal cavity. After creating sufficient pain to render the patient slightly faint and cause uneasiness in the lumbar region, the liquid may be allowed to escape, the canula withdrawn, and the patient placed in bed with the testicle supported.

After-Treatment.—As the object of this operation is to induce adhesion of the sides of the tunica vaginalis, care is required to guard against too much inflammation, and a moderate antiphlogistic treatment may, therefore, occasionally be demanded. After the lapse of about five days, moderate compression by a bandage, or by adhesive strips, will prove useful by approximating the sides of the inflamed cavity and favoring adhesion. Should the lymph, which is sometimes effused into the adjacent parts, leave the testicle considerably enlarged after the operation, the induration may be made to yield to the use of iodine or mercurial ointment.

Cure by the Seton.—Operation.—Puncture the tumor with a seton-needle and a few strands of silk; allow the silk to remain until it excites sufficient inflammation; and then withdrawing it by a few threads at a time, so as to leave one or two to secure the continuance of the opening, pursue the treatment just referred to. Sometimes the trocar and canula are made to enter the tunica vaginalis from below, and pass out of the scrotum above, when, the trocar being withdrawn, a probe, armed with silk, will readily carry the seton through the canula; and, the latter being withdrawn, the seton will be left in position.

The use of the silver or iron wire as a seton has been recommended.

Treatment by Incision.—Operation.—Etherize the patient; puncture the tumor from above downward with a sharp-pointed bistoury, and, introducing the forefinger or director into the cavity, enlarge the opening downward; after which, charpie, lint, or balls of dough may be placed in the cavity to excite irritation, and left there until discharged by suppuration.

Treatment by Excision.—After operating, as in the preceding method, remove a portion of the vaginal tunic either with the scissors or knife, and close the wound in the scrotum by a few stitches of the metallic suture. As the attachment of the tunica vaginalis to the scrotum is loose, the excision of the largest portion of the tunica vaginalis is easy, and the wound which is thus made heals usually under the water-dressing in about twelve days, there being no possibility of a return of the disorder.

Remarks.—The operation for the relief of hydrocele, though apparently simple, occasionally fails to evacuate the liquid, or does not accomplish a cure.

The first is usually the result of carelessness on the part of the operator, and may arise from an error of diagnosis, or from his not rendering the scrotum sufficiently tense to cause the trocar to puncture the tunica vaginalis, the instrument passing between the scrotum and this tunic. Such an accident is by no means rare with inexperienced operators, the puncture being made and the trocar withdrawn without any fluid escaping. If the tunica vaginalis is thickened, or slightly ossified, or if the sac is not rendered tense by compression, or if the trocar is not sharp at its point, or if the canula is not well adapted to the shoulder of the trocar, the perforation of the sac is apt to fail, the tunica vaginalis being pushed before the instrument instead of being punctured. The evacuation of the fluid, and the consequent contraction of the scrotum, are also liable to displace the point of the canula, so that, on attempting the injection, if this method is resorted to, the fluid passes with difficulty, and, instead of inflaming the cavity of the tunica vaginalis, infiltrates the scrotum, and induces sloughing or gangrene. Every precaution should, therefore, be employed to prevent such mishaps in this apparently easy operation. In the selection of a plan of treatment, I prefer either the metallic seton, leaving it in the cavity for several days in order to insure a vent for any liquid which may accumulate, and thus prevent the approximation of the walls of the cavity, or the operation of extirpation or excision of the tunica vaginalis—the latter being preferable in most chronic cases.

§ 1.—Castration.

Castration, or the removal of the testis, although a comparatively easy operation, is one that should not be performed without serious deliberation, and only resorted to when such degeneration is found as establishes the uselessness of the organ beyond a doubt, or the risk of further contamination of the system by its existence. In order to avoid the removal of the gland, ligature of the spermatic artery, or the excision of the vas deferens, has been practiced by Maunoir and Morgan, of Europe, and Jameson, of Baltimore; but in the cases where these means would be advisable, it may be doubted whether castration would not be preferable, because it accomplishes the same object more effectually.

Ordinary Operation of Castration.—The patient being placed upon his back, and the parts shaved of hair, the surgeon should seize the tumor in his left hand, with the palm presenting anteriorly, and force it toward the front of the scrotum, or an assistant may hold it so as to render the skin tense. Then, commencing an elliptical incision through the skin a little below the external abdominal ring, let him continue it below the tumor, or to the inferior part of the scrotum, so as to insure the escape of pus, the two halves of the incision being made to include as much of the scrotum as it is desired to remove. Then, seizing the margin of either half, dissect off its loose connective tissue from around the tumor, until the latter can be turned out of the pouch, Plate LII. Fig. 10.

After isolating the cord from the surrounding parts, feel for the vas deferens, which may be told by its cartilaginous consistence, and, with a few longitudinal touches of the scalpel, separate it from the cord. Pass a ligature around the remaining portion, draw it firmly, tie it in a double knot, allow the ends to remain, and then divide the entire cord below this ligature, especially if carcinomatous disease has demanded the operation. Some surgeons prefer to ligate the vessels of the cord separately as they divide them, but as cancer is the most frequent cause of castration, the general ligation of the cord, excepting the vas deferens, is preferable.

Dressing.—In order to insure a vent for the pus that will promptly collect in the scrotum, introduce a small piece of lint or linen into the lower angle of the incision, unite the centre of the wound by the metallic sutures, and close also its upper angle, applying subsequently the water-dressing, as in simple incised wounds.

CHAPTER III.

STONE AND GRAVEL.

THE next of the affections of the genito-urinary organs to which attention may be directed, is that known as **Gravel** or **Stone**, terms used to designate the formation and arrest, in various parts of the urinary passages, of certain particles of sabulous matter which, when arrested in these passages, are liable to accumulate from fresh particles being added to them, and thus present themselves in the form of **gravel**, or attain such size and solidity as justly entitle them to the name of **stone**.

SECTION I.

GRAVEL.

Varieties.—The sabulous matters found in the urinary passages have been variously classified; in the first place they are divided according to their size, being, when finely pulverulent, spoken of as **sand**, **sediment**, or **deposit**, the last two terms being, however, objectionable, because there may be a sediment or deposit in the urine, which does not consist of calcareous matters, it being caused by the presence of blood, mucus, pus, or semen. The term **sand**, as expressive of the general character of the disorder, is therefore preferable. When sand aggregates to a moderate extent, it is called **gravel**, the larger masses resulting from still further aggregation receiving the name of **stone** or **calculus**.

Etiology.—The disposition to the formation of gravel in the urine is to be found in connection with a state of the kidneys by no means precisely understood. Very often it is hereditary, father and son for many generations laboring under the complaint. As the disease consists essentially in a vitiated action on the part of the kidney, any cause capable of producing or sustaining this disordered action may become the cause of the complaint. Thus, it will be found that among the predisposing causes are certain kinds of food, especially those which abound in the nitrogenized elements, while certain drinks are also said to aid the diathesis in favoring the formation of stone; persons who use much hard cider being said to suffer, while the disorder is also thought to be more common in districts where the water is highly impregnated with limestone than elsewhere, though statistics have not proved this opinion to be correct. Climate, clothing, or any change of circumstances which, by modifying the action of the exhalents of the skin, throw an increased burden upon the kidney, may also become the cause of stone.

These facts are important, because after a stone has been removed from the bladder by operative interference, if the patient be not watched, and the exciting causes removed, or the tendency of the diathesis carefully counteracted, the calculus may be reproduced. It should, therefore, be borne in mind that the **kidney** is the source from which the mischief comes, pathological observations having often revealed the fact that, in patients laboring under gravel or stone, this gland is diseased to a considerable extent, every possible variety of disordered action being seen in it that could be the result of inflammation.

Chemical Composition.—The chemical composition of gravel is varied, though it generally consists of the combination of uric, oxalic, or phosphoric acids, with certain bases, such as lime, ammonia, magnesia, soda, silica, iron, etc., or with a peculiar substance, recently described under the name of **Cystine.**

To that peculiar state of the constitution which predisposes to the formation of these compounds in the urine, the terms **Lithiasis, Lithogenesis,** or stone-producing diathesis, are applied; and, in speaking of the specific deposit which the diathesis induces, the name of the acid that predominates in the gravel is usually prefixed to it: thus we have the uric or lithic acid gravel, as well as that of oxalic and phosphatic acid.

Constituents of Gravel.—The following classification, made by the most recent authorities on the urine, and condensed from them, presents a concise view of the more important ingredients, whether of *sand, gravel,* or *stone,* found as the result of disordered action of the urinary apparatus:—

1. **Uric Acid.**—Free, or combined as a Urate of Ammonia, Soda, etc.
2. **Phosphates** of Ammonia and Magnesia, or of Lime.
3. **Oxalate** of Lime.
4. **Cystine.**
5. **Uric Oxide.**

§ 1.—Uric Acid and the Urates.

Uric Acid, called also **Lithic Acid,** or **Urylic Acid,** is a normal constituent of the human urine, about eight grains of it being excreted daily by a healthy adult. As it is quite insoluble in water, it does not exist free in the urine, but in the state of a soluble bi-urate, probably of soda, though perhaps also of lime, ammonia, etc.

Sand or gravel may be composed of free uric acid, or of its compounds, the urates, and may be separately described.

I. **Sand or Gravel composed of Free Uric Acid.**—Free uric acid is invariably found in the urine in the crystalline form. The crystals may be large enough to be recognized as such by the naked eye, or they may be so small as to require the use of the microscope for their recognition.

In color, this variety of sand may be of any shade between a pale fawn color and yellow, yellowish-red, or red. It is hence familiarly known as yellow or red sand or gravel. It may be visibly crystalline, or, from the minuteness of the crystals, may appear amorphous to the naked eye. The urine is *always acid,* and is generally of a high color and considerable density.

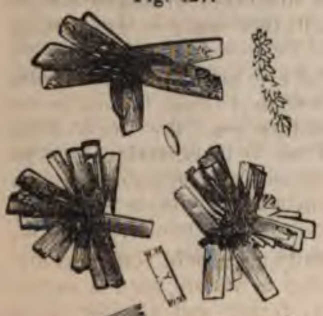
The term **Uric Acid Gravel** should properly be restricted to those cases in which the uric acid forms small concretions, from one-twentieth of an inch in diameter to the largest size capable of escaping through the urethra. A variety of this form of gravel is presented in the concretions called "fusiform," which are often expelled in great numbers by individuals who have passed the period of middle life. They are frequently exceedingly numerous; their form globular; their surface smooth; their color yellow, reddish, or brown.

Chemical Characters.—Deposits of uric acid are not dissolved by *heating* the urine; they are insoluble in acetic or hydrochloric acids, but soluble in concentrated nitric acid. They are soluble in hot liquor potassæ, from which solution they are again thrown down in a crystalline form on the addition of an acid.

Portions of the sand washed and dissolved in nitric acid, yield, on evaporation, a residue of a beautiful pink color, which becomes purple on exposure to the vapor of ammonia. Heated in a platinum spoon, uric acid readily burns with the odor of bitter almonds.

Microscopical Characters.—The crystals of uric acid present, as seen by the microscope, innumerable varieties in their form, all of them, however, being referable to some modifications of the rhombic prism. The most frequent of these forms may be described as rhombic plates, shapes approximating the cube, spindle shapes, elliptical forms, forms resembling the flower of the "lily of the valley," etc. As they occur in urine, they are always colored of a fawn, yellowish, or reddish hue. The crystals may be unattached to each other, or they may cohere together in little stellated masses, which are in fact minute calculi, and which are generally large enough to be seen by the naked eye, resembling grains of Cayenne pepper, Fig. 427.

Fig. 427.



Crystals of Uric Acid. (After Bird.)

Etiology.—We have seen that uric acid exists normally as a soluble urate in healthy urine. If, therefore, we add to healthy urine any acid stronger than the uric in its affinities, as nitric, hydrochloric, or even acetic or lactic acids, the whole of the uric acid will be precipitated in an insoluble crystalline form. In this simple experiment, which the student may readily repeat for himself, is to be found the key to the process by which these deposits are produced. Invariably the deposit is the consequence of the appearance in the urine of some acid capable of decomposing the soluble urates, this being probably in most cases **Lactic Acid**, which is frequently developed in *healthy urine* after it has been passed some hours. This, uniting with the bases, forms lactates, setting the uric acid free. Acetic acid is probably developed, at times, in the same manner, and produces the same results. This process, which in healthy urine does not usually commence for several hours after the urine is passed, is designated by Scherer as the *acid or sour fermentation* of the urine, to distinguish it from the alkaline fermentation which sets in later, and which will be described in connection with the etiology of phosphatic deposits.

The acid fermentation and consequent precipitation of uric acid, which nominally does not take place for some hours after the urine is passed, may, in consequence of constitutional or local conditions which are not yet completely understood, occur preternaturally early, beginning *immediately* after the urine is passed, or even *before* it is voided, in the *bladder*, or, in extreme cases, in the *kidneys*. It is, of course, only in these latter cases, in which the uric acid is precipitated in a crystalline form in the body, that there is danger of the formation of calculi.

It will then be perceived that the condition determining the precipitation of the uric acid is the preternatural acidity of the urine, and not any excess of the uric acid itself. Indeed, deposits of uric acid, if the urine be unnaturally acid, *may* occur in cases in which the total quantity of uric acid passed in the twenty-four hours is actually diminished; and conversely, the quantity of uric acid may be considerably increased, and yet no crystals may be precipitated, provided the necessary condition of acidity be absent from the urine. The necessary acidity of the urine does, however, sometimes coexist with excessive production of uric acid, which will then make its appearance in copious crystalline deposits.

The condition in which excessive production of uric acid habitually occurs is designated as the **Uric Acid Diathesis.** As uric acid is not formed in the kidney, but exists preformed in the blood as absolute urate, the origin of the uric acid diathesis is to be sought, not in local, but in constitutional conditions. Excessive indulgence in animal food, dyspepsia, chronic skin diseases, rheumatism, etc. are among the conditions which are most frequently accompanied by its excessive formation.

The conditions which determine the unnaturally early acid fermentation, by which the uric acid is set free after its secretion as a urate, are not understood. Sometimes the condition is hereditary, father and son for many generations suffering under the complaint.

Treatment.—As the invariable condition determining the deposit of free uric acid is an unnatural acidity of the urine, (acid fermentation,) the first indication is to resort to those remedies by means of which the urine can be rendered alkaline. In many cases this can be effected by limiting the patient to a vegetable diet, which has also the effect of diminishing the actual quantity of uric acid formed in the twenty-four hours. Where, however, this is not convenient, or is ineffectual, the urine can be rendered alkaline and the uric acid held in solution by the administration of the alkalies, their carbonates, or, preferably, their salts, with the vegetable acids; as the liquor potassæ, in the dose of half a drachm, three times daily; bicarbonate of potassa, in doses of a scruple to half a drachm, three times daily; acetate of potassa, in half-drachm doses, thrice daily, etc.

Where, however, the amount of uric acid actually secreted in the twenty-four hours is excessive, (which can only be affirmed after acidulating the whole urine of the twenty-four hours with nitric acid to make sure that all its uric acid is precipitated, and washing, drying, and weighing the sediment,) an attempt must be made to diminish the quantity. This is to be done by abstaining from animal food; by attention to the functions of the skin; by restoring the tone of the digestive organs, if these are disordered; and by moderate exercise in the open air.

§ 2.—Sediments of the Urates.

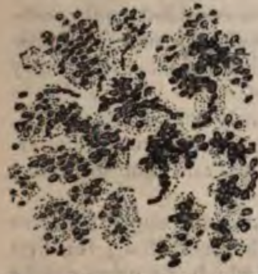
According to Prout and Golding Bird, the usual sediments of **Urates** have ammonia for their base, while soda is regarded as the base by Lehmann, Wedl, and other continental authorities. Hassal and Thudichum are probably correct when they state* that their composition is variable, presenting different proportions of the bi-urates of ammonia, lime, soda, and potash.

Appearances to the Naked Eye.—The urates occur as amorphous sediments, which may be whitish, fawn-colored, pink, purple, or brick-red. The latter form constitutes the well-known lateritious sediment of fevers, rheumatism, gout, etc. The paler forms might be mistaken by the naked eye for sediments of pus; but are readily distinguished by the chemical tests. Concretions and minute calculi of the urates may also occur.

Chemical Characters.—The urates are decomposed, with the subsequent precipitation of pure uric acid in crystals, on the addition of any strong acid in the urine. If the urine containing them be gently heated over a lamp they disappear, on account of their greater solubility in hot than in cold water; but they reappear when the urine again cools. This is the most reliable chemical test.

Microscopical Characters.—The urates present, under the microscope, innumerable varieties of excessively minute globules, frequently adhering together in a linear manner. An admixture of crystals of uric acid is very common, Fig. 428.

Fig. 428.



Urate of Ammonia under the Microscope. (After Bird.)

Etiology.—As the urates are more soluble in hot than in cold water, it frequently happens that urine which is perfectly clear, as first passed, deposits a precipitate of amorphous urates as it cools. This may occur on account of an actual increase in the quantity of urates formed in the twenty-four hours, in consequence of any of the causes which were mentioned in connection with the increased daily formation of uric acid. Or the daily formation of urate remaining normal, a deficiency of the *water* of the urine may occur to such an extent that the normal quantity of urate is no longer soluble in it when cold. In either case the precipitation most frequently occurs out of the body on the cooling of the urine; it is only occasionally that the scantiness of the urine, or the excessive quantity of the urate is so decided that the precipitation takes place within the body, and the urine is passed already turbid. It is in this latter case only that there is danger in the formation of a stone of the urate.

Besides the above cases, it must be noted that in *ammoniacal* urine the urates, even if normal in quantity, are precipitated along with the phosphates; they then assume microscopical forms unlike those above described, (dumb-bells, globules, potatoe forms, etc.,) and may enter with the phosphates into the formation especially of the outer layers of stone.

Treatment.—Where a deposit of the amorphous urates coexists with scanty urine, simple dilution, as by copious drinks, with or without the use of diuretics, will cause the precipitate to disappear. Where the deposit occurs in cases in which the quantity of urine is normal, excessive production of urates may be inferred, and should be treated on the general principles above laid down for diminishing the formation of uric acid.

§ 3.—Of the Phosphates.

Phosphoric acid, combined with several bases in the form of **phosphates,** invariably exists in the healthy urine. Under circumstances which will be

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[*] Lancet, p. 163, Sept. 1858.

discussed hereafter, some of these compounds are precipitated, and give rise to phosphatic sand or gravel.

Appearances to the Naked Eye.—Deposits of the phosphates are always whitish or yellowish-white, except when they are stained with blood. They frequently exist when conjoined with the excessive production of mucus or mucoid pus, and the sediment is then tough and stringy.

The urine is generally pale, of a low specific gravity, and alkaline, and is often ammoniacal. When the bottle is held between the eye and the light, brilliant points can often be seen that are due to the reflection of light from the angles of the crystals.

Chemical Characters.—These deposits are not dissolved when the urine is heated; they are insoluble in hot liquor potassæ, or in aqua ammoniæ, but are soluble in dilute hydrochloric or nitric acids. The presence of pus, mucus, or blood may materially interfere with the results of these tests, in which case a microscopical examination becomes necessary.

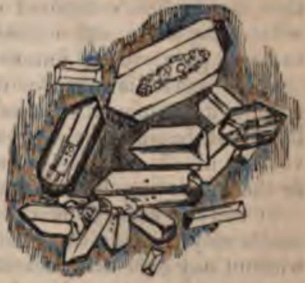
Microscopical Characters.—The microscopical examination of phosphatic sediments shows two distinct orders of form: one of which is the amorphous powder, (generally the phosphate of lime,) and the other the prismatic crystals. The most abundant of the crystals are modifications of the *three*-sided prism, and are a compound of phosphoric acid with ammonia and magnesia,—ammonio-phosphate of magnesia.

Less abundant but sufficiently common are the *four*-sided prisms, which, except in the number of sides, sufficiently resemble the above. They are composed of phosphoric acid in combination with ammonia and soda, (ammonio-phosphate of soda.)

These crystalline forms, especially the former, which is most abundant, are generally embraced under the common designation of the "triple phosphate."

The ammonio-phosphate of magnesia occurs also in foliaceous and stellated forms, which, however, belong to the same system of crystallization as the prisms.

Fig. 429.



Crystals of the Ammoniaco-magnesian Phosphates. (After Bird.)

Etiology.—In order to appreciate the etiology of phosphatic deposits, it must be borne in mind that phosphoric acid is a normal ingredient of healthy urine, about 56 grains of the acid per day being excreted by the adult.*

In healthy urine this acid exists combined with four bases, forming phosphates of soda, potassa, lime, and magnesia. Of these, the phosphates of soda and potassa (alkaline phosphates) are soluble; while the phosphates of lime and magnesia (earthy phosphates) are insoluble in water, but are held in solution in urine by the acid phosphate of soda,† in the solutions of which they are freely soluble. If now the urine be rendered alkaline by any cause, the acid phosphate of soda being neutralized, the earthy phosphates are no longer held in solution, but are at once precipitated. If the alkali be a fixed one, as soda or potassa, the precipitate consists of an amorphous powder merely; but if the alkali be ammonia, it forms with it in neutralizing the acid phosphate of soda, the four-sided prisms of the ammonio-phosphate of soda, which, being insoluble, are precipitated, while another portion of the ammonia, combining with the phosphate of magnesia, forms the threesided prisms of the ammonio-phosphate of magnesia. The phosphate of lime precipitates as an amorphous powder.

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* Thudichum, p. 416.

† Ibid.

These changes, which can readily be produced artificially by the addition of ammonia to urine, occur spontaneously when healthy urine putrefies. It was stated, in connection with the etiology of uric acid, that healthy urine undergoes a process of change if allowed to stand, which is designated as *the acid fermentation;* after the acid fermentation has continued for a period which is shorter in warm than in cold weather, a new process is set up, by which, the mucus of the urine acting as a ferment, *ammonia* is formed at the expense of the *urea*, and not merely renders the urine alkaline, but causes a precipitation of the phosphates, as above described. This process is known as the *alkaline fermentation* of urine, and is accompanied, when the development of ammonia is considerable, by a precipitate of the *urates* as well as of the phosphates.

Alkaline fermentation of the urine does not usually occur until after the acid fermentation is complete, and not until some time after the urine is passed. In certain morbid conditions of the urinary passages, however, the mucus or mucoid pus produced appears to act as an energetic ferment, determining the decomposition of urea into ammonia, with precipitation of the phosphates and all the phenomena of alkaline fermentation. This premature alkaline fermentation is especially frequent in the chronic cystitis so common in old men, which is hence often described as phosphatic cystitis. The same phenomena occur in the cystitis set up by the presence of a stone in the bladder; and hence it is that the outer layer of stones of the most variable composition is so often composed of a phosphatic crust. Alkaline fermentation within the body, and consequent phosphatic deposits, is also common in cases of paralysis, of antero-posterior curvature of the spine, etc.

Other causes may render the urine alkaline, when voided, besides the premature development of alkaline fermentation. In the latter case, the alkalinity will be due to the presence of fixed alkali, and not of ammonia or a volatile alkali. Exclusive vegetable diet and the administration of alkalies or their salts may be mentioned as the prominent causes of this condition.

It will be seen, from the above remarks, that abundant phosphatic deposits may occur in the bladder, even giving rise to the formation of stone, without any excessive secretion of phosphates, and consequently without the existence of any *true* phosphatic diathesis. Various causes, however, may lead to an actual increase of the quantity of phosphates secreted. Among these causes may be mentioned the excessive ingestion of animal matter rich in phosphates, and, perhaps, excessive mental exertion or anxiety, which, by increasing the tissue metamorphosis of the brain, gives rise to this effect Excess in the quantity of phosphates secreted does not necessarily determine phosphatic deposits, though they may coexist if the urine from any cause becomes alkaline. In any case, *quantitative analysis alone*, and not the presence or absence of a deposit, can determine the excessive or deficient secretion of the phosphate.

Treatment.—As the condition determining the phosphatic deposit is the alkaline reaction of the urine, the first indication is to restore the urine to its natural acidity. Unfortunately this is not always easy, or even possible. The internal administration of the mineral acids, though valuable in improving the general health, and thus indirectly benefiting the patient, will not render the *urine acid*, and cannot, therefore, be relied upon for the purpose of putting a stop to the deposit.

If alkaline urine has resulted from exclusive vegetable diet, the discreet employment of animal food will often restore the desired acidity. If its cause has been the use, for medical purposes, of the salts of the alkalies, they must be abandoned. But, in the majority of cases, the urine is alkaline from the presence of ammonia, and as the cause of the premature alkaline fermentation which constitutes the essence of the disease is to be sought in some disorder of the urinary passages, and especially of the bladder, the local treatment addressed to the local lesion becomes most important. If the local lesion be due to the presence of a stone, little benefit can be anticipated until this is removed, and in many cases the trouble is simply chronic cystitis, recognizable by the admixture with the urine of pus or mucoid pus. The symptoms and treatment of such cases, as detailed in connection with acute cystitis, is perfectly applicable to these cases—the use of *injections* into the bladder being especially serviceable in the cystitis complicated with stone For this purpose, lukewarm water is generally sufficient; and it may be thrown in by means of a double canula catheter, the bladder being thus completely washed out. The operation may be repeated two or three times a week with the happiest effect.*

§ 4.—Oxalate of Lime.

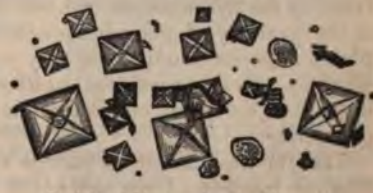
The only compound of oxalic acid which gives rise to the formation of urinary deposits or of calculi is the oxalate of lime.

Appearances to the Naked Eye.—The crystals of the oxalate of lime are so minute, and their transparency so great, that the deposit due to their presence might readily be overlooked by the naked eye. When the glass containing the urine is held between the eye and the light, the deposit appears, however, as a faint, mucous-like cloud, in which minute shining points can sometimes be seen, due to the refraction of light from the angles of the crystals, but these appearances may be completely masked by the presence of an amorphous deposit of the urates, or by the admixture of the urine with blood, etc. The urine is acid in its reaction when first passed, and presents no special characteristics. Small concretions of the oxalate of lime sometimes occur.

Chemical Characters.—When oxalate of lime is passed in the form of minute gravel-stones or calculi visible to the naked eye, it is easily recognized by chemical tests; but no chemical process is available for the detection of the ordinary deposits of oxalate of lime, these being readily recognized by microscopic examination.

Microscopical Characters.—The oxalate of lime appears in two diverse forms, octahedra and dumb-bells, the octahedra and their modifications being the most frequent. These octahedral crystals are exceedingly minute, and in their most common form resemble squares marked by a cross. The dumb-bells are less frequent. Bird regarded the latter not as an oxalate, but as an oxalurate of lime; while Frick, of Baltimore, denies that dumb-bell crystals are composed of a lime salt, declaring them to consist of uric acid. It is highly probable, therefore, that several varieties of dumb-bell crystals, as yet insufficiently studied, may occur in the urine; but the evidence at present preponderates in favor of the opinion that among these we may enumerate dumb-bells of the oxalate of lime.

Fig. 430.



Oxalate of Lime under the Microscope. (After Bird.)

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* Bird on the Urine, p. 265, last edit.

Etiology.—Crystals of the oxalate of lime very frequently form in perfectly healthy urine during the process of the acid fermentation. According to Scherer, whose views have been adopted by Owen Rees and others, this is due to the formation in the urine, during the acid fermentation, of oxalic acid, which did not exist in it when passed; just as lactic acid is formed in the urine under similar conditions. The oxalic acid thus produced combines with lime, and is precipitated generally in octahedra. This process, which usually does not occur until some time after the urine is passed, may take place immediately afterward, or even before the urine is evacuated, in the bladder or the kidneys. According to this account, which appears to have the weight of evidence, and such names as Lehmann, Scherer, Bence Jones, and Owen Rees in its favor, the presence of the crystals of the oxalate of lime in the urine when passed, is no evidence of a special diathesis, but simply an indication of premature acid fermentation; and the formation of these crystals *after* the urine has passed, is to be regarded as a mere indication of the chemical changes of fermentation, and of no practical importance to the surgeon.

Nevertheless, admitting this view to be correct, and that crystals of the oxalate thus formed are to be found in an immense number of the specimens of perfectly healthy urine within a few hours after it has been evacuated, it cannot be denied that copious deposits of these crystals in the urine before, or immediately after it is passed, are frequently associated with a peculiar form of dyspepsia, accompanied by lumbar pains and various phenomena of nervous irritation, as first indicated by Golding Bird; though the precise relation between the constitutional condition and the local deposit has yet to be determined. It is to this condition that the term **oxalic diathesis, or oxaluria,** should be restricted. Oxalate of lime may also appear in the urine temporarily after the ingestion of the soluble oxalates. Thus, a copious deposit of oxalate of lime can be produced at pleasure by the internal administration of the binoxalate of potash, and the same may also occur after eating rhubarb pies, or other vegetable food rich in soluble oxalates.

Treatment.—If the crystals form only *after* the urine is passed, no treatment is required, and the deposit is not to be regarded as a morbid condition. Where, however, the copious deposit of oxalate of lime is accompanied by the dyspeptic symptoms above alluded to, these must be treated on the general principles applicable to such cases. It is in this condition that the internal administration of the nitromuriatic acid (or the other mineral acids) has proved so useful, its exhibition being sometimes speedily followed by disappearance of the deposit.

§ 5.—Cystine.

A rare form of calculus, first described by Wolaston, is that composed of the peculiar crystalline compound, rich in sulphur, which has received the name of **Cystine.** Since that time it has been occasionally noticed, both in calculi and as a deposit, in Europe and this country.

Appearances to the Naked Eye.—Deposits of cystine are white or fawn-colored in appearance, and sometimes much resemble phosphatic deposits. The urine is usually yellow, of high specific gravity, and neutral or alkaline in reaction.

Chemical Characters.—These deposits further resemble those of the phosphates in being undissolved when the urine is heated, and soluble in nitric and hydrochloric acids. But they can be at once distinguished by their ready solubility in aqua ammonia.

Microscopical Characters.—Cystine presents under the microscope the appearance of transparent six-sided tables, variously aggregated together.

Etiology.—The etiology of these rare deposits is quite unknown, and nothing available in the way of their treatment has been, as yet, proposed.

§ 6.—Uric Oxide.

Still rarer and less understood are the deposits and calculi of **Uric Oxide.** This substance, which is normally excreted in the urine of spiders and scorpions, has never been met with in human urine, except as the ingredient of a few calculi and rare urinary deposits. It was first noticed as a calculus by Marcel, and afterward by a few other observers. It has been observed in deposits by Berzelius, Morin, of Geneva, and one or two others.

The characters of these deposits have not been accurately described, and nothing is known of their etiology or treatment.

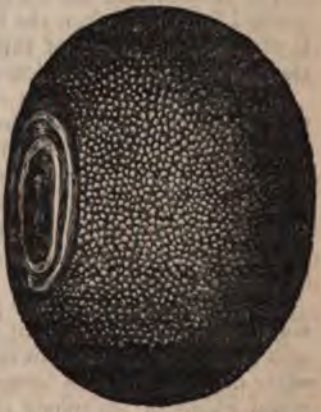
SECTION II.

CALCULUS, OR STONE.

When any of these sabulous deposits find in the bladder a nucleus, such as a drop of blood or of mucus, or a grain of wheat, a bit of straw, or any substance which the morbid imagination of a patient may have led him to introduce, or which has entered accidentally, they accumulate upon it, and go on to such an extent as to result in the formation of a true stony mass or **Calculus.** The calculi thus formed are to be regarded as foreign bodies, and act as such, producing irritation of a serious character in the mucous membrane of the bladder, the effects of which are felt by the whole system. The vesical irritation and inflammation thus resulting may even be so severe as to cause the death of the patient, post-mortem examinations showing pathological changes in the coats of the bladder caused by this irritation, the coats being sometimes enormously thickened, while the ureter is distended and sacculated, and the whole urinary apparatus presents appearances which almost prevent the recognition of its original structure.

Varieties of Calculi.—The various kinds of calculi may be thus briefly described:—

Fig. 431.



Uric Acid Calculus, showing its finely tuberculated surface. (After Gross.)

That of *uric* or *lithic acid*, and its compounds, is the most common, constituting two-thirds of all calculi. They are seen of various colors, often presenting a fawn or yellowish hue, though sometimes they are so dark as to deserve the appellation of a mahogany color. They are generally of a flattened oval shape, and if a section is made, they will be observed to consist of concentric laminæ, arranged around a central nucleus; each layer showing its distinct character by a variation in the color,

Fig. 437. The surface is either faintly tuberculated, Fig. 431, or more soft and smooth. In size they vary from the circumference of a hazelnut to that of a hen's-egg.

Fig. 432.

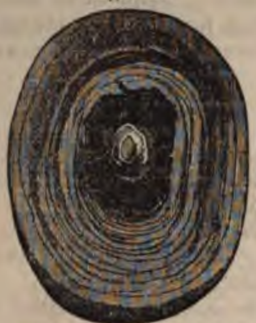


Fig 433.

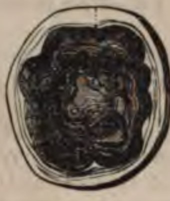


Fig. 434.

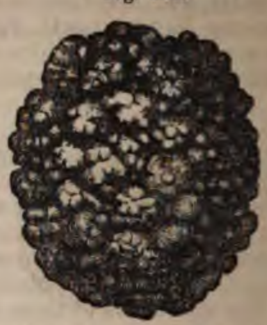


Fig. 432.—Nucleus surrounded by Oxalate of Lime, and this covered by concentric layers of Urate of Ammonia. (After Gross.)
Fig. 433.—Triple Phosphate surrounding a Mulberry Calculus. (After Gross.)
Fig. 434.—Oxalate of Lime, or Mulberry Calculus. (After Gross.)

Tests.—Calculi containing uric acid or its compounds may be recognized by the following chemical tests: They will dissolve in nitric acid with effervescence, and this solution, being evaporated to dryness, will give a pink color, which will become violet when held over the fumes of ammonia. They also dissolve in caustic potassa, from which, by the addition of an acid, colorless crystals of uric acid may be obtained.

The **Calculus of Oxalate of Lime** is next in frequency, and generally presents itself in the form which, from the character of its surface, is described as the mulberry calculus. It is tuberculated, but irregularly spherical, and is nearly always single.

Its color may be almost white, but more frequently brownish or brown, with sometimes an approach to dark-olive green.

In its formation it frequently has a nucleus of some foreign substance, or of some other variety of urinary concretion, especially uric acid.

The tuberculated surface is often rough and sharp pointed, thus inducing marked irritation when the bladder contracts closely upon them. Hence it is that the symptoms of this variety are generally more severe, in proportion to the size of the calculus, than those of any other class of stone.

In size these calculi are seldom larger than a walnut or small egg. In texture they are extremely hard, and are susceptible of a fine polish.

Tests.—If a small portion of one of these calculi be heated on platinum foil with the blow-pipe, it first becomes black, from the charring of the intermixed organic matters, but, as the heat continues, it becomes white.

The residue is alkaline to test paper, and effervesces with the dilute acids; it is a mixture of carbonate of lime with caustic lime, the oxalic acid having been decomposed by heat.

The Stone formed by the phosphates has generally a grayish-white color, and is quite soft, so that it can easily be crushed. Phosphatic layers are also frequently observed incrusting nuclei, or alternating with layers of some other deposit. Stones formed entirely of phosphatic matters may be composed wholly of phosphate of lime, or of triple phosphate, or, by far more frequently, of a mixture of the two.

Tests.—Stones consisting of a mixture of the triple phosphate with phosphate of lime are known as **Fusible Calculi**, from the readiness with which they melt before the blow-pipe. They are soluble in dilute mineral acids, from which they may be precipitated by the addition of ammonia. The same chemical test applies to calculi composed of the phosphate of lime or of the triple phosphate only; but these calculi are fused with the greatest difficulty, and may thus be discriminated. Calculi of phosphate of lime, if dissolved in acetic acid, will precipitate oxalate of lime on the addition of oxalate of ammonia, which will serve for the differential diagnosis between them and the triple phosphate.

Fig. 435.

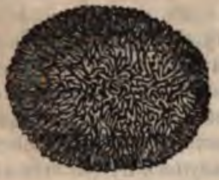


Fig. 436.

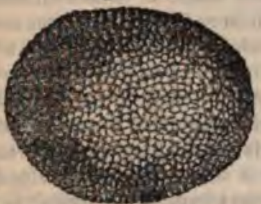


Fig. 437.

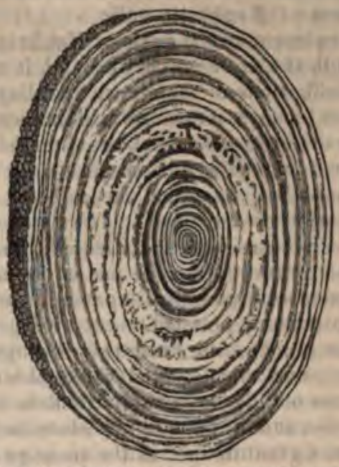


Fig. 435.—Calculus of Ammoniaco-Magnesian Phosphate, entire, exhibiting its shining crystalline surface. (After Gross.)
Fig. 436.—Cystic Oxide Calculus. (After Gross.)
Fig. 437.—Section of an Alternating Calculus, chiefly composed of uric acid. (After Gross.)

Calculi of **Cystine** are rare; they are yellowish and wax-like, greenish-gray or greenish-brown. They may be recognized by their solubility in aqua ammonia, from which solution six-sided crystals of cystine may be obtained on evaporation.

Calculi of **uric oxide*** are still rarer than those of cystine. They much resemble in appearance those of uric acid, but assume a waxy appearance when polished. They have been so seldom observed—in three cases only, according to Thudichum—that it is unnecessary to occupy space by describing their chemical peculiarities in this place.

Symptoms.—As it is apparent that calculi originate in the kidney, the earliest symptoms of the tendency to the formation of these bodies will usually be found in connection with this gland; thus there will be pains in the loins, this pain being at times much more severe than at others, and resembling, when at its height, the pain of colic, for which it may be mistaken, particularly when accompanied, as it sometimes is, with vomiting, and a peculiar sense of constriction in the epigastric region as if the patient was bound around the stomach with a cord, the urine being scanty, high colored, and often mixed with blood. There is also very apt to be a burning sensation in the urethra, due to sympathetic irritation.

When gravel or a pebble passes into the ureter, if its size is such as to present any obstacle to its free passage, a new train of painful symptoms are rapidly developed: thus there will be pain in the course of the ureter, violent spasmodic contraction of the cremaster muscle, the testicle being often drawn quite up to the external abdominal ring, a fact which is of much value as a means of diagnosis; while, if these symptoms continue for from twenty-four to forty-eight hours, there will very often be present more or less febrile reaction, heat of skin, and diminished secretion, this condition being usually terminated by sudden relief. The suddenness of the relief experienced by the patient is another diagnostic sign of importance, and is caused by the passage of the stone from the ureter into the bladder. All these symptoms are sometimes so severe as well to deserve the name which is often applied to them of **Nephritic colic.**

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* Synonyms, Xanthine or Xanthic Oxide.

Treatment of Gravel, or **Nephritic Colic.**—As the passage of a pebble through the ureter is very painful, it requires prompt and efficient treatment, the indications of which are to allay the pain and favor the passage of the pebble by such means as will induce relaxation of the system, the quickest mode of doing which is by the administration of anæsthetics. In the relaxation induced by partial anæsthesia—for it is not necessary to carry it to the fullest extent—the passage of the calculus will be favored both by gravity and by the action of the urine. If, however, anæsthetics are not at hand, or are from any cause contraindicated, the same result may be obtained, though not so promptly, by the use of opiates, and if, in spite of these measures, the calculus lingers in its passage through the ureter, the effect of an active purgative may be tried.

One point in the treatment is of great importance, and yet is often overlooked, and that is, until the pebble has passed completely from the kidney into the bladder, and the patient is entirely relieved for the time, the use of diuretics should be carefully abstained from, for it will readily be understood that the great danger in the passage of the pebble through the ureter is that it may cut through it, and thus give rise to urinary infiltration into the abdominal cavity, or that, blocking up the ureter, it may dam up the urine, which, accumulating behind it, may produce distention and rupture of the canal, the latter danger being greatly increased by the increased secretion of the kidney while the pebble is in the ureter; but after the pebble has passed into the bladder, mild diuretics and diluents will often be useful by allaying pain and irritation.

Having reached the bladder, the pebble may afterward, if not too large, be passed by the urethra, and to favor this the mild diuretics and diluents above spoken of are also serviceable. But most frequently it remains in the bladder without causing any inconvenience until attention is directed to it by the gradual setting in of all the symptoms of stone in the bladder.

Stone in the Bladder may be found in all ages, in all climates, in patients of all habits and temperaments, and in both sexes, though more frequent in the male than in the female, on account of the larger size and shorter length of the female urethra, which therefore permits an incipient calculus to escape.

Stone has also been found, in children at birth, of such a size as proved that it must have existed for some time in the fœtus in the womb; while it has been found in old men, as well as in all intermediate ages. Children, however, are rather in the majority, as of 5376 cases recorded by Civiale, 2416 were in children, 2167 in adults, and 793 in very old persons.

Of the children, 1946 were under 10 years of age.

This complaint also prevails in all climates, though some seem more favorable than others, owing to a variety of causes, among which the character of the waters of certain streams perhaps plays an important part. In the

United States, according to the work of Gross,* the disease is most common in Kentucky, Ohio, Tennessee, and Alabama; less frequent in Pennsylvania, Delaware, Maryland, Virginia, North and South Carolina, Louisiana, and Arkansas; in New England, Canada, Texas, Mexico, and California it is more rare; while Missouri, Iowa, Michigan, New York, etc. are comparatively exempt.

As regards the color of the patients, the white man suffers more than the black, and it is said to be a rare thing to see a negro affected with stone. Out of a very large number of cases seen by me in this country and in Europe, including a close observation of Civiale's wards for many months, I do not remember to have noticed more than two cases in the negro.

Symptoms.—The symptoms which generally accompany the presence of stone in the bladder are as follows: There is a difference to be observed in the manner of urinating, the stream being frequently and suddenly arrested by the stone coming over the orifice at the neck of the bladder and closing it. In a few moments after, the stream will again begin to flow freely, as the stone has rolled away. The patient now begins to complain of pain, and this pain —which is due to the irritation about the neck of the bladder, like many other irritations upon the course of nerves which are referred to their peripheral extremities—is noted at the head of the penis. This pain at the head of the penis, due to irritation in the neck of the bladder, is not merely one of the symptoms of stone, but is generally found to accompany any irritation of the neck of the bladder produced by other causes. Thus, it is often found accompanying the neuralgia of the neck of the bladder, which sometimes occurs in connection with spermatorrhœa; and is also found as one of the symptoms of cystitis. The pain at the head of the penis is, however, more marked in cases of stone than in the other disorders, owing to the permanency of the cause, and leads the patient, particularly if a child, to handle the penis, and pull upon the prepuce constantly. As a result, the prepuce becomes very much elongated, and phymosis is induced, so much so that it is sometimes difficult to introduce a sound, while the fingers of the little patient, from the constant dribbling of urine, have the cuticle macerated, and the finger-tips shriveled, so as to resemble a washerwoman's fingers. As the rectum is closely in contact with the bladder, it shares in the vesical irritation, and there is tenesmus, this tenesmus being not unfrequently accompanied with prolapsus ani.

The urine at first is clear, and may or may not present, when allowed to cool, characteristic deposits. But by and by it becomes muddier or dark colored from an admixture of mucus or of blood, and may contain little particles of stone, which have been broken off and escaped.

All these symptoms are liable to be much aggravated in spells, there being then intense pain and great constitutional disturbance, accompanied sometimes by more or less febrile reaction. Under these circumstances, the patient is said to be laboring under a **fit of the stone.**

The symptoms of stone in the bladder, though often very marked, are sometimes quite obscure, and the surgeon has occasionally no reason to suspect in the least the presence of a stone, until it is accidentally discovered by an instrument passed into the bladder for some other purpose. Very often, although the symptoms are such as fully to justify a belief in the presence of a calculus, and the "fits of the stone," so called, are frequent and severe, the general health of the patient does not appear to suffer; the bloom still rests on the cheek of the child, and the frame of the adult preserves its strength, while in other cases the constitution suffers greatly, and the patient emaciates and sinks rapidly.

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* A Practical Treatise on the Diseases, Injuries, and Malformations of the Urinary Bladder, the Prostate Gland, and the Urethra, by Samuel D. Gross, M.D. Philadelphia, 1855.

Diagnosis.—The diagnosis of stone will be given in connection with the description of the operation.

Prognosis.—The prognosis of stone in the bladder will depend very much upon the circumstances of the case; thus, if the health of the patient is good, the stone moderate in size, and the case one suitable for lithotripsy, the prognosis will be favorable; while if the general health of the patient is exhausted and broken down, the prognosis will be grave. If lithotomy is required, the dangers of the operation must always be taken into consideration in giving a prognosis; while in both operations it should be recollected that, after the removal of the stone, if the diathesis is not combated and overcome, the patient will be liable to a re-formation of the stone.

Treatment.—The treatment of stone is of two kinds—the first being palliative and the second curative.

As the irritation of a fit of the stone is very great, a palliative plan of treatment becomes necessary to relieve its violence. Thus an attempt may be made to render the surface of the stone smooth, if it is rugged, by the injection of mucilages into the bladder, or the free administration, by the mouth, of alkalies and diuretics. When the patient is suffering acutely, resort may be had to various other plans of obtaining relief. Of these the simplest is to seat him in a warm hip-bath, which is generally useful by relaxing the spasmodic contractions of the bladder. If this is not sufficient, an anodyne injection, consisting of a proper amount of laudanum in a little starch water, may be given, or a suppository of opium introduced into the rectum, or resort may be had to a moderate use of anæsthetics.

In the curative treatment, the operations of lithotripsy or of lithotomy, as hereafter stated, will be demanded for the removal of the calculus.

CHAPTER IV.

OPERATIONS FOR THE REMOVAL OF STONE FROM THE BLADDER.

Two operations have been suggested for the removal of a calculus from the bladder and the relief of the symptoms created by its presence: the one—**Lithotomy**—consisting in making an incision through the neck of the bladder by perforating the perineal structure; the other—**Lithotripsy**—being accomplished by instruments introduced into the viscus through the urethra, by means of which the stone is crushed, and voided in fragments through the urethra.

In the selection of either, the surgeon should be mainly guided by the peculiarities of the case. If the patient is in feeble health, with disordered digestion, a diseased bladder, and thickened, muddy, or muco-purulent urine, lithotomy may present the best chance; but if the stone is soft and friable, —as may be told by the sensation given to the sound—if the bladder is apparently healthy, and the general constitution not much impaired, lithotripsy should be selected, as being attended with less risk, and also as least likely to give rise to trouble in the execution of the functions of the bladder and testicles at a subsequent period.

The operation of incising the male perineum and extracting a calculus has always been regarded as one of the most important efforts of an operator, and the anatomical relation of the parts cannot, therefore, be too often referred to by those contemplating its execution, and will now be given.

SECTION I.

SURGICAL ANATOMY OF THE MALE PERINEUM.

The **Perineum**—περι, around, and νεος, a temple—is formed entirely of such soft tissues as fill up the inferior outlet of the pelvis, and has in the male no openings except those for the urethra and rectum.

In its general outline, the perineum may be limited to the space included between the bones forming the inferior strait of the pelvis, though for the purposes of regional anatomy, it has sometimes been circumscribed yet more, by being described as "the isosceles triangular space formed by the bones of the arch of the pubis, and by a line drawn transversely from the tuberosity of one ischium to the other, in advance of the anus."

The tissues entering into the composition of the perineum are the skin, superficial fascia, loose connective tissue, loaded with fat, and varying very much according to the general condition of the patient, the perineal muscles, the triangular ligament or middle perineal fascia, and the deep or pelvic fascia.

In the middle of this region, as thus bounded, we should notice that the larger triangular space above described can be readily subdivided into two equilateral triangles by the raphé, this line being the boundary of the symmetrical portions found on each side.

Of these we should note the root of the corpus cavernosum, the erector penis muscle, the transversus perinei, and sometimes the transversus perinei alter, part of the levator ani, or muscle of Wilson, as well as the branches of the internal pudic vessels and nerves.

In the middle line of the perineum, we also find, in addition to these muscles, the skin and fascia, the accelerator urinæ, the sphincter ani, the bulb of the urethra, its membranous portion, the triangular ligament, the rectum, prostate gland, and the orifice of the neck of the bladder.

The dimensions of the perineum in man have been carefully studied by surgical anatomists in order to decide how large a calculus can be extracted through this part. According to Dupuytren, the transverse diameter of the perineum varies from two to two and a half inches, while its depth, or antero-posterior diameter, is about four inches. The distance of the peritoneum from the skin, on a level with the recto-vesical depression between it and the verge of the anus, varied from two inches and eight lines to three inches and six lines, as examined upon twelve subjects, and from the mucous surface of the neck of the bladder to the raphé, ten lines in advance of the anus, it was from two inches to two inches and eight lines.*

The relative position of the prostate gland, and its capacity for dilatation, have also been accurately studied in consequence of its necessary division in the extraction of calculi through this region. According to Velpeau,† the prostate gland is situated about eight lines from the symphysis pubis, and its sides about an equal distance from the rami of the pelvis.

"The transverse incision on one side of the prostate, as ascertained by the measurement of the gland by Bell, in more than forty subjects, can only be about ten lines in length, give an entire opening of two inches and nine

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* Blandin, Anat. Topograph., p. 383.

† Anat. Chirurg., tome ii. p. 236.

PLATE LIII.

INSTRUMENTS EMPLOYED IN LITHOTOMY.

Fig. 1. A strong Round-bellied Scalpel for the first incisions of the perineum. *Kolbè's pattern.*

Fig. 2. A Sharp-pointed Bistoury to open the membranous portion of the urethra and expose the groove of the staff, which it will do better than the scalpel. In using it, the membranous portion of the urethra should be punctured as near to the prostate as possible, and then laid open from behind forward. *Kolbè's pattern.*

Fig. 3. Dupuytren's double Lithotome Caché. 1. The beak adapted to the groove of the staff. 2, 3. The blades expanded laterally, but shutting up in the body of the lithotome. 4. The lever for expanding the blades. 5. A screw to regulate the expansion of the blades. *Charriere's pattern.*

Fig. 4. A side view of Physick's Cutting Gorget, the blade being detached at pleasure from the handle. 1. The handle. 2. The stem-beak. 3. The cutting edge. 4. The screw to fasten the blade to the beak and handle. *Kolbè's pattern.*

Figs. 5, 6, 7, 8 represent other blades, which may be adapted to the same handle, and selected in reference to the width of the perineum in each patient; they vary from one-fourth of an inch to one inch, increasing by fourths or eighths, at the option of the operator. The size and angle of the blade and handle are similar to that of the common gorget. The length from the beak to the angle of the handle is four and a half inches, and the handle is four inches. As the blade can be readily detached, it may be perfectly and readily sharpened, and made to cut directly up to the beak of the instrument.

Fig. 9. Barton's Stone Forceps with fenestra to diminish the expansion of the blades when holding the stone. *Kolbè's pattern.*

Figs. 10, 11. The ordinary Stone Forceps, of different sizes.

Figs. 12, 13. Different forms of the Scoop. *Kolbè's pattern.*

Fig. 14. Earle's Forceps for crushing calculi which are too large to be extracted whole. 1. The screw to close the handles. *Kolbè's pattern.*

Plate 53.

Fig. 1.

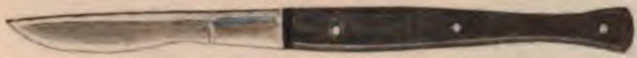


Fig. 2.

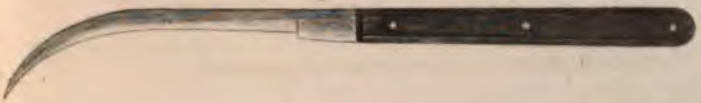


Fig. 3.

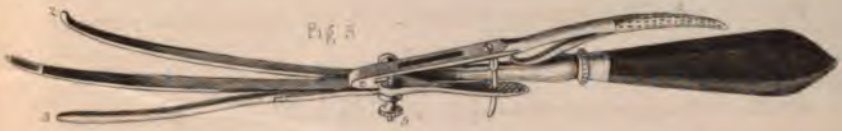


Fig. 9.

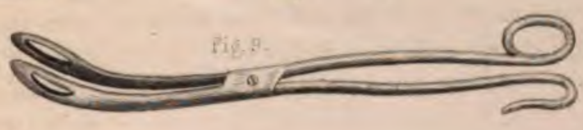


Fig. 10.

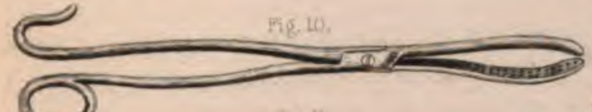


Fig. 11.

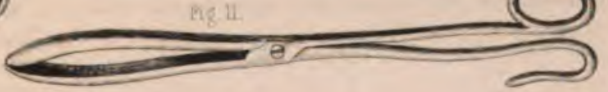


Fig. 12.

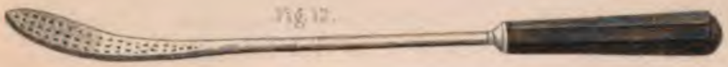


Fig. 13.

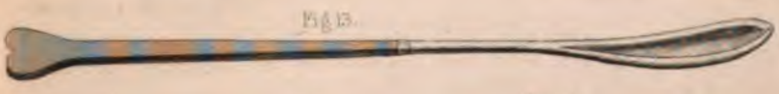


Fig. 4.

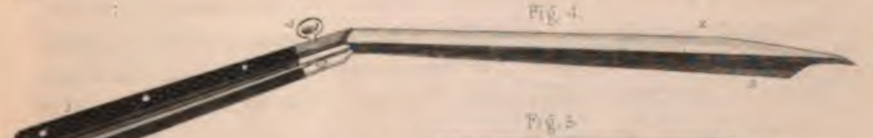


Fig. 5.

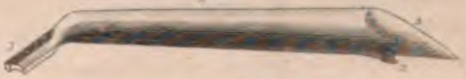


Fig. 6.

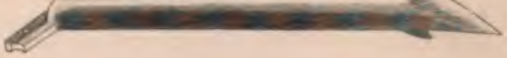


Fig. 7.

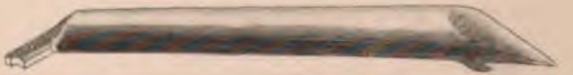


Fig. 8.

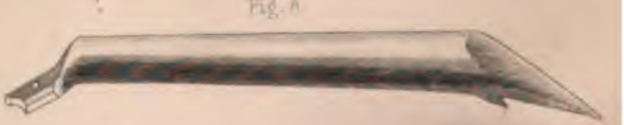
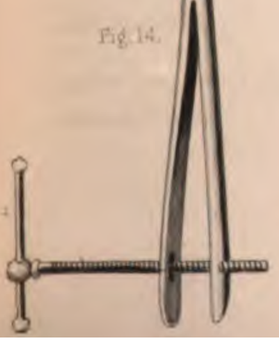


Fig. 14.



lines in circumference, and allow of the exit of a spheroidal body ten or eleven lines in diameter. The oblique incision downward may be from eleven lines to an inch long, create an opening three inches and a line in circumference, and be large enough for a calculus one inch in diameter.

"When the prostate is incised on both sides, the transverse incisions being each nine or ten lines long, there will be an opening four inches five lines and a half in circumference, which therefore permits the extraction of a calculus one inch and a half in diameter. Two perfectly oblique incisions will form an isolated triangular flap, the base of which is one inch and three-fifths in extent, and lay bare, when the flap is lowered in front, a triangular opening altogether a little less than four inches, and consequently less than the transverse opening. An oblique incision to the left side, eleven lines or an inch long, and another transverse one to the right, ten lines long, permits the largest opening, and with the dilatation of the urethra, gives an opening of four inches and eight lines, while it is one which can be easily expanded. This last is the incision preferred by Senn."*

The membranous portion of the urethra is ten lines long, and is situated behind the triangular ligament, and in front of the prostate.

The bulb of the urethra is attached to the anterior face of the triangular ligament, is formed by a spongy or erectile tissue, which is nearly deficient in children, fully developed at puberty, and is longer than its width in old men.†

The transversus perinei artery supplies the bulb of the urethra, and passes to it fourteen lines in advance of the anus. The branches of the venous vesical plexus, which surround the neck of the bladder, lie outside of the prostate in the thickness of its sheath.

SECTION II.

OPERATION OF PERINEAL LITHOTOMY.

Perineal Lithotomy may be performed in three ways: in one, the incision opens the membranous portion of the urethra and the prostate on the left side of the perineum, and is called the **Lateral operation**; in the second, both sides of the prostate gland are divided, constituting the **By-Lateral operation**; and in the third, it is divided in the line of the raphe, and is therefore termed the **Median operation.**

§ 1.—Preparatory Steps.

Before proceeding to employ any of the means that are proper, as preliminary measures, in the operation of lithotomy, it is essential that the presence of the stone be positively established.

Diagnosis of Stone in the Bladder.—Various symptoms have been recorded by surgical writers as pathognomonic of the existence of a calculus; but, though useful as aids in diagnosis, they cannot be relied upon by themselves; sounding, or the direct contact of an instrument with the stone, being the only certain sign of its presence.

Sounding.—To prove the existence of a stone by sounding, the surgeon should select two steel sounds of different curves, and with smooth polished handles, warm and oil them, and then introducing one into the bladder in the manner directed for catheterism, move its point about until he can cause it to touch the calculus, when the sensation which will be communicated to the fingers will prevent a mistake. The advantages of employing sounds with different curves will be found in the facility with which the smaller curve may be made to sweep the bas-fond of the bladder, when the greater convexity of a more curved instrument might cause the instrument to pass over the stone without touching it. When a sound is in the bladder, its point should be gently turned from side to side as well as to the top and bottom of the viscus, lest the stone be encysted or concealed behind a fold of the mucous membrane owing to the thickening of this coat, or to its being rendered prominent by the hypertrophied condition of the muscular coat.

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* Malgaigne, Op. Surg., Philad. edit. p. 497.

† Blandin, p. 386.

In order to obtain an accurate touch, the broad handle of the sound should be perfectly smooth, and held between the thumb and forefinger, so as to obtain as great a surface of contact as possible. By attaching a flexible stethoscope to the handle of the sound by means of a little clamp, or by means of a sounding-board of light, compact and sonorous wood, the sense of hearing may also be made to aid materially the diagnosis. In several instances I have caused the click of a Sound against a stone in the bladder to be heard by a medical class of five hundred students, through the intervention of the sounding-board attached to the Sound after it is introduced into the bladder.

On the part of the patient, there are also certain circumstances which are favorable to the establishment of a diagnosis by these means. Thus the bladder, at the time of sounding, should hold sufficient water to keep its sides moderately distended. When, therefore, the patient has urinated a short time previous to the visit of the surgeon, a silver catheter should be first introduced, and about twelve ounces of tepid water slowly injected, so as to distend the bladder, and prevent its closing on the instrument. If, after sounding with the bladder in this condition, a stone cannot be felt, the fluid may be allowed to escape, or be voided by the patient, in order that the contraction of the bladder may bring the stone in contact with the instrument. Small calculi in patients with diseased prostate are also sometimes difficult to detect, unless the finger is introduced into the rectum; and the same manœuvre will often prove useful in other cases. A change in the position of the patient sometimes renders the presence of a stone apparent, which could not previously be felt, by causing it to touch the sound; thus, after lying on the back, a position first on one side and then on the other, cautiously taken, will often cause the instrument to touch the stone; and, in two instances, Physick succeeded in thus detecting a calculus where other means had failed, the patient being placed in one instance so nearly on his head that the fundus of the bladder became the most depending part.*

The record of cases in which patients have been cut, without the operator finding any stone, as well as the history of those whose bladders contained large calculi, the presence of which had not been detected during life, are sufficiently numerous to lead every operator to use the utmost caution in sounding his patient. Thus, a fibrous tumor, attached to the prostate gland by a slender pellicle, is reported by Velpeau† to have been mistaken for stone; while Desault, Cheselden, Cooper, and Velpeau‡ cite other cases where even large stones existed without being recognized. By a resort to anæsthetics many of the former sources of difficulty can now be removed, so that one familiar with the changes of structure liable to be produced in the bladder by disease, can hardly fail, with proper care and repeated examinations, to satisfy himself fully of the actual condition of this viscus.

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* Dorsey's Surgery, vol. ii. p. 179.

† Mott's Velpeau, vol. iii. p. 888.

‡ Op. cit., vol. iii. p. 891.

In addition to the knowledge gained, by sounding, of the presence of a stone, the operator should also learn the probable size, consistence, number, and position of the calculi, all of which will materially aid him in deciding upon the kind, as well as the steps of the operation, that may be required for their removal.

§ 2.—Constitutional Treatment.

The presence of the stone being in most instances the cause of much of the suffering and general constitutional disturbance seen at this period of the complaint, it might be supposed that its prompt removal would afford the best chances for a recovery; but experience has firmly established the fact that the greatest success attends such operators as have first carefully attended to the preparation of their patients.

To prepare a patient for the operation of lithotomy requires a correct judgment, and the combination of the highest medical with the best surgical experience, as the means must vary in different cases; but in every instance the patient should be placed in as healthy a condition as possible. He must, therefore, neither be too much depleted nor stimulated, while every secretion should be noted, in order to tell the proper condition of his whole system. As a general rule, it is beneficial to evacuate the bowels thoroughly, but gently, before operating; to obtain perfect rest; to have the mind free from anxiety, and to place the digestive and thoracic viscera, as well as the skin, in a good condition by means of alteratives, sedatives, and diaphoretics. No better means can be resorted to for the relief of the train of symptoms that have been termed a "fit of the stone" than the free use of alkaline and diluent drinks; the hip-bath; anodyne suppositories or enemata, and the occasional inhalation of ether. I have in several instances afforded much relief simply by administering boluses of the following alkalies and diuretics:—

℞.—Saponis Hispan.,
Carb. sodæ exsiccat., āā ʒj;
Ol. juniperi, gtt. lx.
M. Et ft. mass dein in pil. xxiv dividend. S. One every four hours.

In cases of gravel, the same formula, by neutralizing the uric and lithic acid, has caused the evacuation of such an amount of sand as induced patients to think the stone was being dissolved.

§ 3.—Local Preparatory Means.

The local preparatory measures required in lithotomy refer both to the part of the body to be operated on and to the apartment selected for the performance of the operation.

The perineum of a patient about to be cut for stone should in all cases be perfectly cleansed and shaved, in order to avoid the irritation liable to be caused after the operation by the adhesion of unhealthy discharges to the hair of the part. The rectum should also be thoroughly emptied by a laxative enema, and then put at rest by the use of an anodyne; but the bladder should be kept nearly full, either by inducing the patient to retain his urine, or if this cannot be done, or if the secretion is deficient, by previously injecting tepid water as directed in sounding.

In selecting a room, it is important to have one that is well ventilated, and with a good light falling either from above or from one side; to have a firm narrow table, and sufficient stands or tables for the reception of instruments, etc.

After selecting the table, it should be covered by a mattress and pillows, the end of the mattress being doubled under and tied or pinned firmly together, so as to elevate and support the hips. Over this should be placed a thick blanket, and over this a sheet, the end of which should hang down to the floor, in order to receive the blood, urine, feces, etc. The resort to a shallow box or pan of sawdust at the foot of the table, and placed just beneath the end of the sheet, will also aid in preserving the cleanliness of the apartment.

In addition to such instruments as may be required for the special mode of operating selected by the surgeon, there should also always be prepared a large syringe and catheter; a pitcher of barley-water to wash out such fragments of the calculus as may be created in extracting the stone, together with a little cup of sweet oil, sponges, basins, water, towels, and stimulants should the occasion require them.

Five assistants may be required to aid the operator. The first should hold the staff and scrotum of the patient, according to the directions furnished by the surgeon. Two others should place the patient's knee in their axilla, while their forearms should be passed round his leg, so that by bearing their weight upon his pelvis they may steady it upon the table, and, by keeping his thighs separated, render the perineum tense. The fourth should stand at the patient's head and shoulders, to administer the anæsthetic, watch its effects, and furnish drink or such other attentions as the circumstances may call for; the fifth should remain in the room to wait upon all.

SECTION III.

THE LATERAL OPERATION.

The division of the perineum upon the left side of the raphé, so as to open the bladder through the left half of the prostate gland, is an operation of considerable antiquity, and by many regarded as the best mode of operating where the stone is not excessively large. Although those selecting it have from time to time deemed it advantageous to modify the various instruments by which the division of the prostate was to be effected, there is but little difference in the other steps of the operation, and this account will therefore be limited to the operation as practiced by Cheselden, Abernethy, Cline, and others, in Europe; by Physick, Dudley, Barton, McDowell, and others, in the United States.

§ 1.—Instruments that may be wanted during the Operation.

In order to meet all the contingencies that may arise in the lateral method of lithotomy, the surgeon should prepare and place upon a tray the following articles, which are mostly shown in Plate LIII., to wit: one large and deeply grooved staff, to pass into the bladder; one large round-bellied scalpel with which to incise the perineum; one sharp-pointed bistoury to open the membranous part of the urethra, if the scapel is not sufficient; a gorget or knife to incise the prostate; forceps of different sizes, with and without fenestra; a scoop; Earle's crushing forceps, or Heurteloup's lithontripteur; a tenaculum; Physick's forceps and needle, in case of wound of the internal pudic artery; and ligatures, needles, and lint for arresting the hemorrhage, or plugging the wound, if requisite.

Introduction of the Staff.—The patient being etherized, and placed as before directed, the surgeon should oil and introduce a sound into the bladder to render the presence of the stone evident to his assistants, and, having done so, withdraw the sound and introduce the staff; or, the sounding may be practiced the day before the operation, and verified simply by the staff at the time of the operation. The latter being then accurately adjusted in the median line of the body, the first assistant should hold it, while the patient's hands and feet are bandaged together, if the assistants are not men of experience, but with the employment of anæsthetics and with good assistants this is not necessary, though it is much the safest practice. The patient being now in position, with the perineum fully exposed, the surgeon should feel for the tuberosity of the ischium, the bulb of the urethra, and the body of the staff, so as to recognize these points of reference, and, being satisfied with the position of the staff, direct the assistant how to hold it. On this point there is much difference of sentiment, such surgeons as prefer to be guided in their incisions solely by the staff, liking it to bulge out in the perineum and incline well toward the left aside; while others, relying upon their anatomical knowledge, prefer having its point kept accurately in the bladder, with its concavity close under the arch of the pubis, and its handle turned a little to the right groin, so as merely to present its groove toward the left side of the raphé. Of the two methods, I prefer the latter, relying upon the staff rather in cases of error or deviations in incising a deep perineum than for the primary incisions. In my opinion, any surgeon who cannot open the membranous portion of the urethra without the aid of a staff, is but badly qualified for the performance of the operation of lithotomy.

§ 2.—Lateral Operation with the Cutting Gorget.

The surgeon being conveniently seated on a moderately low stool or chair without a back, or else kneeling on one knee, should commence the operation by placing the first and second fingers of his left hand upon the perineum near the raphé, so as to steady the skin, and then holding the scalpel in his right hand like a pen, puncture the skin and fat by a perpendicular pressure, at a point one line to the left side of the raphé, and immediately behind the scrotum, that is, at one which corresponds with the lower side of the arch of the pubis, or is about one inch in advance of the sphincter ani muscle. Commencing at this point, let him now, by a steady pressure, continue the incision in a straight line to a spot corresponding nearly with the middle of the fibres of the sphincter ani muscle, and about half way between it and the tuber ischii, the incision being about three and a half inches long in the adult, and boldly made, so as to divide the parts neatly, while it should be of sufficient depth, especially in its middle, to reach the membranous part of the urethra. The beginning and end of this first incision need not, however, be deeper than the skin and fat, while the greater depth of its middle should be such as would make a conical wound, the apex of which should be toward the bladder, Plate LIV. Fig. 1. If the first incision is not deep enough in its centre, two or three touches of the scalpel may be made, so as to divide the transversalis and levator ani muscles with the lower edge of the triangular ligament and expose the membranous portion of the urethra, the rectum being depressed and pushed toward the right side by the left forefinger in the wound, while the scalpel continues the incisions. When the membranous portion of the urethra is so exposed that the groove of the

PLATE LIV.

LATERAL OPERATION FOR LITHOTOMY.

Fig. 1. A view of the position of the patient, surgeon, and assistants, as far as they could be shown upon one figure, in the lateral operation for stone. 1, 2. Hands of the first assistant holding the staff vertically, and holding up the scrotum. 3. Left forefinger of the surgeon depressing the rectum in the deep incision in the perineum. 4, 4, 5, 5. The hands and arms of the assistants· Their arms are, however, represented as placed upon the thighs of the patient instead of nearly parallel with his legs, as they ought to be; but this position was incompatible with the view. 6. The appearance of the incision in a deep perineum, immediately after puncturing the membranous portion of the urethra. *After Nature.*

Fig. 2. Manner of holding and passing the knife into the groove of the staff when the bladder is opened by it instead of the gorget, its handle being gently depressed so as to keep its point in the groove of the staff as it enters the bladder. 1. The staff. 2. First position of the knife. 3. Its final position in the neck of the bladder. *After John Bell.*

Fig. 3. The right forefinger passed into the bladder along the staff, so as to recognize the position of the stone before passing in the forceps. 1. The staff. 2. Hand of the surgeon. *After John Bell.*

Fig. 4. An outline to show the manner of enlarging the wound by means of the probe-pointed bistoury. 1. The staff in position. The forefinger of the surgeon introduced into the opening in the neck of the bladder with its palmar surface pressing against the back of 3, a probe-pointed bistoury in the act of enlarging the incision in the prostate gland. *After John Bell.*

Fig. 5. Outline representing the forceps as grasping one stone, while a second is represented below it. 1, 1. Improper line in which to attempt extraction, as it exposes the neck of the bladder to contusion against the arch of the pubis. 2. Forceps seizing the stone. 3, 4. Proper direction of the forceps in the last efforts for extraction of the calculus. *After John Bell.*

Fig. 6. A view of the mode of retaining the stone in the scoop during its extraction by this instrument. 1. The scoop. 2. The left forefinger of the surgeon. *After John Bell.*

Plate 54.

Fig. 3.

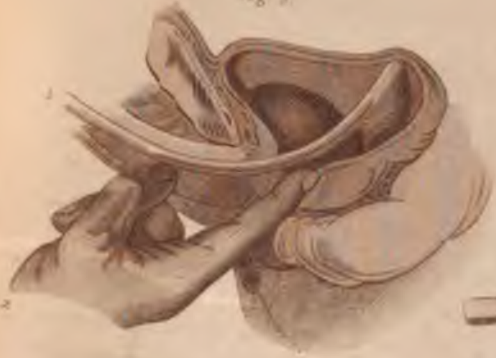


Fig. 4.

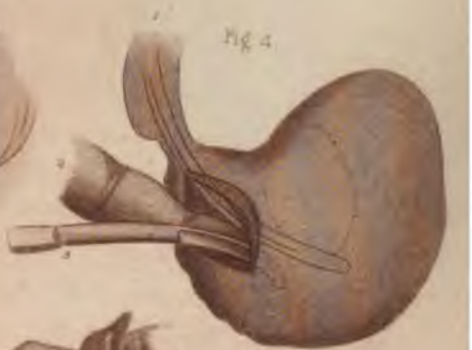


Fig. 1.

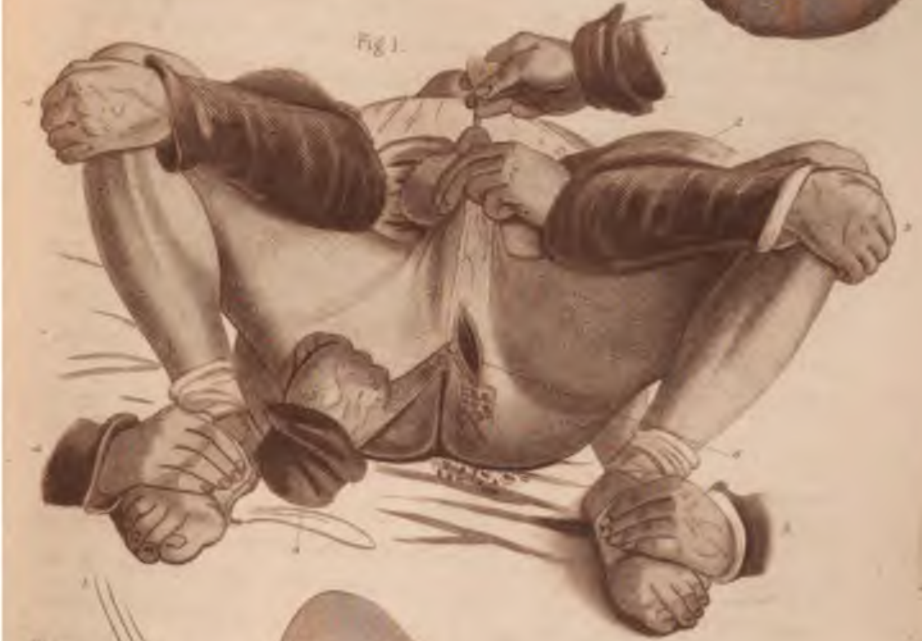


Fig. 2.

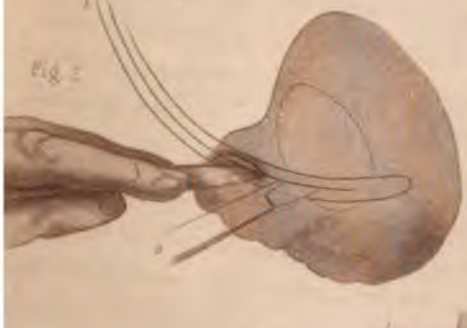


Fig. 6.

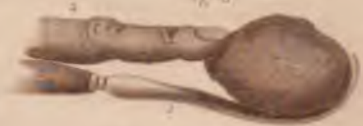
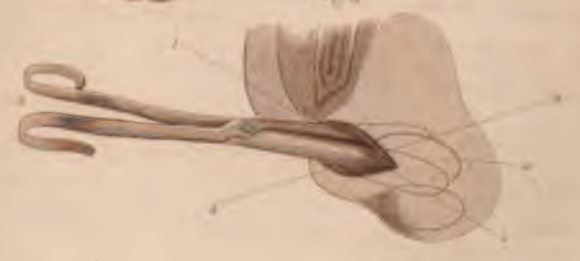


Fig. 5.



staff may be readily felt, pass the left forefinger into the wound, while the hand is in extreme pronation, so that the radial edge of the finger may be turned downward, the ulnar side of its pulp and the point of the nail being made to touch the staff, while its back presents to the left descending ramus of the pubis. Then laying down the scalpel and taking up the sharp-pointed bistoury, pass it flatwise, or with its back to the rectum, along the left forefinger as a director; carry its point to the bottom of the wound; puncture the membranous portion of the urethra so as to enter the groove of the staff, as may be told by the escape of a little urine and the contact of the instruments; and then, cutting from behind forward, lay bare the staff by one stroke, from the prostate to the bulb, when more urine will follow, and the staff will be clearly felt and seen. Then promptly taking the gorget, dip its point into oil, place its beak in the groove of the staff; stand up; take the handle of the staff from the assistant; balance the two together, the edge of the blade being inclined downward and outward, and then by a steady movement press the gorget along the staff into the bladder. As its cutting edge progresses, the handle of the gorget should be made to descend in front of the anus so as to keep the beak perpendicularly applied to the staff, and prevent its slipping, while the blade should be so conducted as to pass nearly parallel to the ramus of the ischium. As soon as the prostate is incised, a gush of urine will follow, and show that the bladder has been opened. Then withdraw the gorget promptly, but leave the staff in the bladder; again pass in the left forefinger; touch the stone with it, Plate LIV. Fig. 3; direct the assistant to withdraw the staff; and, taking the forceps in the right hand, with the thumb and fore or second finger thrust through the rings in its handles, pass the point of the forceps into the bas-fond of the bladder along the left forefinger, with the blades closed; touch the stone, and endeavor to seize it in the forceps, so that its longest diameter shall not be transverse to the wound; or if this cannot be readily done by the right hand alone, take one handle of the forceps in each hand, turn the instrument flatwise, so that it may act as a scoop, and then, fishing about, get the stone into the grasp of the instrument. After the stone is properly grasped by the forceps, withdraw the left forefinger, slide it along the forceps to the centre screw, and, by a gentle lateral and up-and-down movement, extract the calculus by such a moderate amount of force as may be necessary to dilate the wound, but not bruise it, Plate LIV. Fig. 5.

One calculus being removed, introduce the right forefinger and feel for others, or for fragments; then pass into the bladder, through the wound, a large catheter; adapt to its free end the nozzle of the syringe containing barley-water, and wash out the clots of blood, fragments, etc. that may be left behind; after which it only remains to arrest any severe hemorrhage that may show itself, and to dress the wound in the manner hereafter stated.

Remarks on the Lateral Operation.—The section of the prostate gland, as accomplished by Physick's gorget, Plate LIII. Fig. 4, is one of great certainty and cleanness, creating a wound which is admirably adapted to healing, in consequence of the accuracy with which the two surfaces may be approximated.

The advantages of the ordinary gorget have been variously estimated at different periods, some surgeons asserting that its operation was too mechanical, and its division of tissue a "stab in the dark;" while others have highly lauded it. In the United States, the English cutting gorget was the favorite instrument of Physick, who modified it so that its blade could be separated from the beak, and thus made to receive a perfect edge—a modification of great value, and one which really gave this instrument a new character, making it a perfectly firm and keen knife. The gorgets that have since been made in the United States have been mostly of this pattern, and have been employed by Gibson, Rhea Barton, Randolph, and McDowell, as well as by most of the lithotomists of Philadelphia. The venerable Dudley, of Kentucky, whose success as a lithotomist is so widely known, having operated more frequently with success than any other surgeon, always employs the gorget, though he prefers that of Cline, of England.

An examination of the objections that have been urged against the use of the gorget shows that the faults charged upon it are chiefly due to the old English gorget, or that known as the gorget of Hawkins, as this cannot be sharpened close to the beak, and, in passing along the staff, is therefore apt to leave a portion of the prostate uncut at the sides of the staff, in consequence of which the gorget is liable to be thrown out of the staff, and made to cut toward the rectum. Many of the instances referred to by the opponents of the instrument are also rather examples of the want of skill in the operator than of defects in the instrument, as a good surgeon could hardly fail to lithotomize a patient with any instrument.

There are, however, many operators in the United States who do not use the gorget, preferring beaked knives, of various kinds and shapes, most of which are apparently favorites, from personal peculiarities in operating. In many instances such knives are only modifications of a gorget, act in the same manner, but do not make so accurate an incision, and are liable to create an opening in the pelvic fascia by leading the operator to incise the prostate to too great an extent laterally. In a deep perineum it is always difficult to judge of the position of the point of a knife, even when apparently directed by the left forefinger; but with a staff held in the median line of the body, with its curve close under the pubis, and with the beak of a gorget well placed in it, it is impossible to extend an incision beyond the limits of the width of the blade. The advantage and disadvantage of the gorget is, however, a subject which has engaged powerful advocates on both sides, and I shall therefore dismiss it with the simple statement of individual preference for the gorget of Physick, though at the same time I should not hesitate to cut for stone with a staff and pocket bistoury, if nothing else could be obtained, nor doubt the possibility of any skillful surgeon operating neatly and properly with any instrument when a correct anatomical knowledge of the structure concerned was made to direct it. The choice of a knife is the least important part of any operation, and the discussions spent on the shape of instruments would be much more valuable if more closely connected with the anatomy of the region and less with the mechanical ideas of the cutler.

§ 3.—Operation with the Single Lithotome Cache of Frere Cosme.

The single lithotome cachè or concealed lithotome of Frere Cosme resembles that of Dupuytren, Plate LIII. Fig. 3, and has but one blade. It is introduced into the bladder by passing its beak into the staff, when the latter has been exposed as in the preceding operation; when, carrying its point into the bladder and then opening the blade by pressure against the handle, the prostate and neck of the bladder are to be incised while the instrument is being withdrawn in a perfectly horizontal direction. If the handle of the lithotome is too much elevated, the lower surface of the bladder will be exposed to injury; while, if it is much depressed, the incision will be too small. If the blade is directed outward, the pudic artery may be wounded, and if too much downward, the rectum* may be opened.

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* Malgaigne, Philadelphia edit. p. 505.

Remarks.—In very many instances, I have operated upon the subject with this instrument, as well as with that of Dupuytren, in the manner usually directed by the French surgeons, but have always felt the uncertainty of the extent of the incision thus effected. The liability of the blade to spring; the difference in the resistance offered to its escape by different perinei; the liability to too great expansion, etc., have satisfied me that it cannot bear a comparison either with the gorget of Physick or with what has been termed the "beaked knife of Liston." Its chief recommendation appears to be the difficulty of wounding the rectum. Such an event would certainly be a strong recommendation of the instrument, if lithotomy was to be performed by every individual, but cannot prove so to an accomplished surgeon—and none but a good surgeon should attempt this operation.

SECTION IV.

THE BILATERAL OPERATION.

In the **Bilateral Operation of Lithotomy,** the bladder is opened by an incision through each half of the prostate gland, and a wound made, through which a calculus may be extracted of somewhat larger dimensions than is possible by the lateral section. From having been revived and brought into notice, as well as modified by Dupuytren in 1824, it is often spoken of as his operation, though Celsus, it is well known, was also familiar with a similar method.

Operation of Dupuytren.*—**Instruments.**—The instruments employed by Dupuytren were: 1. A sound, which was lighter than the ordinary sound, sloped off at the end of its grooves, and expanded for two inches in length, at the point where it most curved, so that it might the better distend the urethra. 2. A double-edged scalpel fixed in a handle, and sharp on each edge for about one-third of an inch from its point. 3. A double lithotome, Plate LIII. Fig. 3, the two blades of which opened in one handle, and were so acted on by two levers as to separate in a curved direction, and divide each side of the prostate in its oblique diameter.

Operation.—The patient being placed as before directed, and the position of the various points of reference accurately recognized, Plate LV. Figs. 1, 2, the staff should be introduced and held in a perfectly perpendicular direction, while the surgeon extends the integuments of the perineum with the fingers of his left hand, and makes a semicircular incision with the double-edged scalpel held in his right, commencing on the right side at a point half way between the tuberosity of the ischium and the anus, passing half an inch in front of the anus, and terminating on the left side of the perineum at a point corresponding with the starting-point on the right, Plate LV. Fig. 3. By continued, but rapid incisions, the superficial fascia, anterior point of the sphincter ani muscle, and the connective tissue are divided, and the membranous part of the urethra laid bare, when the nail of the left index finger enables the surgeon to feel the groove in the staff, which may then be exposed, as before directed, by means of a bistoury. The forefinger, during all this period, should be made to depress the rectum in order to prevent its injury. After opening the urethra for one-third of an inch, use the left forefinger nail as a guide to the lithotome caché, and introduce the instrument by holding it in the right hand with the thumb beneath and the two fingers above, presenting it to the staff, so that its convexity may look downward. The con-

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* Malgaigne's Operative Surgery, Philadelphia edit. p. 507.

PLATE LV.

THE OPERATION OF LITHOTOMY AS PERFORMED IN THE BILATERAL SECTION, WITH THE LITHOTOME CACHÈ OF DUPUYTREN.

Fig. 1. Position of the patient, with lines drawn on the perineum to show the points of reference and the direction of the incision. The subject being in the position of lithotomy, the testicles and penis have been turned up, and the perineum divided into two equilateral triangles, the angles of which are made to touch the bones around the perineum. 1. Pubis. 2, 3. Tuber ischii. 4. Coccyx. 2, 3, 5. Line of external incision. *From Froriep, but after Dupuytren.*

Fig. 2. Dissection of the same subject. The fascia superficialis has been turned up from the edge of the incision, so as to show the accelerator urinæ muscle and the transversus perinei arteries. The sphincter ani is seen below, and the divided fibres of part of the levator ani are shown in the figure. 1. The skin. 2. Fascia superficialis. 3. Sphincter ani muscle. 4. Line of the median incision through the anterior fibres of the levator ani muscle. 5. Accelerator urinæ muscle. 6. Perineal arteries. 7. Perineal fascia dissected up, and turned over the body of the penis. *From Froriep, but after Dupuytren.*

Fig. 3. The External Incision in Bilateral Lithotomy. 1, 2. The hands of the first assistant holding the staff vertically, and elevating the scrotum. 3. The left forefinger of the surgeon depressing the rectum. 4. Right hand about terminating, 5, the incision. The external incision should be made from left to right, with its convexity forward, so as to form an arc of about 100°.

After Bourgery and Jacob.

Fig. 4. Section of the prostate with the double lithotome cachè upon a subject which had been dissected, so as to show the incision, the anterior portions of the sphincter and levator ani muscles having been removed. 1. Accelerator urinæ muscles. 2, 3. Internal pudic artery and nerve. 4. Transverse perineal artery. 5. Hand of the surgeon. 6. Levers which regulate the blades of the lithotome. *After Bourgery and Jacob.*

Fig. 5. Lateral section of the prostate as made by the single lithotome cachè, a portion of the sphincter and levator ani and anterior end of the anus being removed in order to show the prostate gland. 1. Bulb of urethra. 2. Membranous portion of urethra. 3. Prostate gland. 4, 5. Lithotome in position. 6. Corpus cavernosum. 7. Symphysis pubis. 8. Vesiculæ seminales. 9. Rectum.

After Bourgery and Jacob.

Plate 55

Fig. 1.

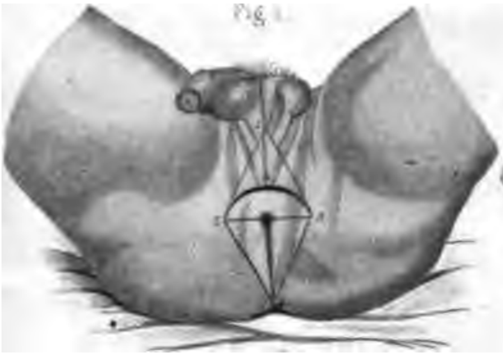


Fig. 2.

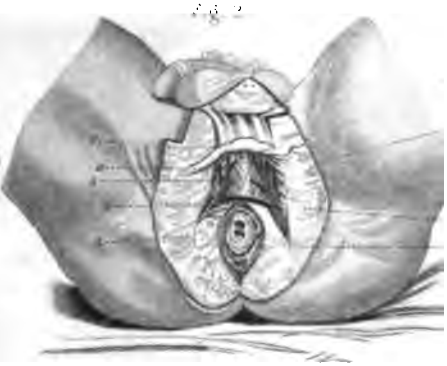


Fig. 3.

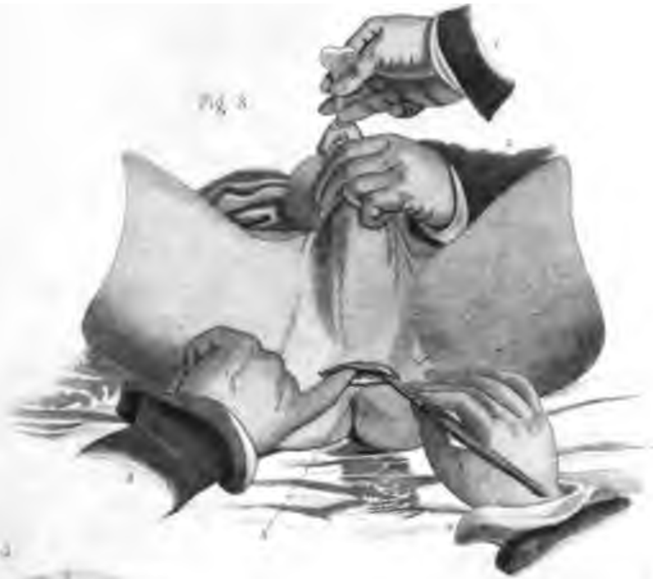


Fig. 4.

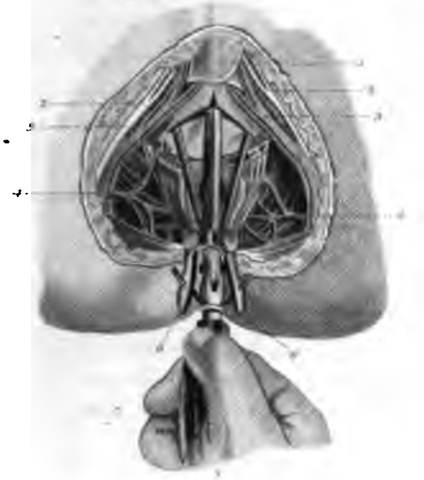
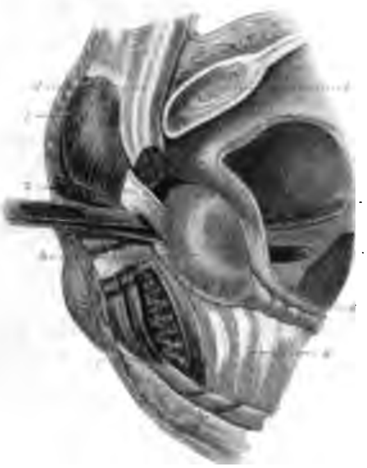


Fig. 5.



tact of the two instruments being now recognized, the surgeon should take the handle of the sound in his left hand, and, elevating it so as to place its curve close under the symphysis pubis, slide the lithotome along its groove into the bladder; then, withdrawing the staff, turn the lithotome so as to present its concavity downward, or toward the anus, and, grasping the lever, depress it to the handle of the instrument so as to unsheath the blades, withdrawing the instrument progressively downward until it cuts its way out, Plate LV. Fig. 4.

The left index finger, being then introduced through the wound into the bladder, should examine the extent of the incisions, and if they are not sufficiently large, direct a probe-pointed bistoury so as to enlarge them, Plate LIV. Fig. 4. But if they are large enough, the forceps should be introduced, and the stone extracted as before directed.

The width of Dupuytren's incision, when widest, was not more than two inches, or one inch through each lobe of the prostate, so that the incision did not pass the circumference of the gland, and therefore did not open the reflection of the pelvic fascia.

Operation of Ogier, of Charleston.—A boy, thirteen years of age, with a large calculus, was operated on as follows: The rectum being emptied, and a staff placed in the bladder, a semilunar incision was made in the perineum just under the bulb of the urethra, commencing about half way between the anus and the tuberosity of the ischium on the right side, and terminating at the same point on the left side, so as to divide the skin and perineal fascia. This being rapidly increased in depth at its centre, the staff was soon felt with the point of the scalpel, a small puncture made in the membranous portion of the urethra, and then Dupuytren's double lithotome being introduced into the bladder, the staff was withdrawn, the lithotome turned with its concavity downward and the neck of the bladder divided from within outward by expanding the blades of the instrument so as to make it cut as it was drawn out. The stone having been then seized with the forceps, was readily extracted, though it measured two and a half inches in length, three and a half in circumference, and weighed one ounce three drachms.

Operation of R. D. Mussey, of Cincinnati.—With a rather narrow scalpel, the superficial crescentic incision is made with its convexity anterior, so as to expose the staff at the membranous portion of the urethra, Plate LV. Fig. 3. A straight, probe-pointed narrow bistoury being then passed along the groove of the staff, with its edge turned toward the left side until it enters the bladder, the point of the left index finger is slid along the back of the bistoury, and made to press it against the prostate so as to divide the latter sufficiently to admit the point of the finger into the bladder, when the staff should be withdrawn and the prostate further divided, if necessary. The finger being then rotated, the palmar surface of its point should be made to rest upon the right side of the prostatic portion of the urethra, the bistoury be turned upon the finger to the opposite side, and the right side of the prostate also divided as far as is necessary, the stone being afterward extracted as usual.

Operation of Fergusson, of England.—Under the impression that a straight line in the course of the raphe with diverging slips on each side of the anus, (like a Y reversed ⅄,) would permit more expansion of the wound than any other form of external incision, Fergusson employed it with satisfaction in a case of lithotomy, after having tried it in the operation of lithectasy, or extraction of a calculus by opening the membranous portion of the urethra and dilating the neck of the bladder, as proposed by Willis. Eve, of Nashville, Tennessee, has also recently adopted this incision in preference to the semicircular cut of Dupuytren.

Operation of Paul F. Eve, of Georgia.—The staff being introduced into the bladder, a short incision is made directly in the raphe at the bulb of the urethra, the direction being changed at a very oblique angle at the end of about three-fourths of an inch, in order to terminate at a point midway between the anus and the left tuber ischii. With the edge of the knife now turned upward, penetrate the tissues, and commence the other leg of the Λ at a point on the right side corresponding to the one just terminated on the left. This incision being deepened as the instrument ascends, arrives at the middle of the perineum with its edge turned directly upward, when the urethra is opened and the staff exposed, after which the operation is completed by the lithotome in the usual way.

Remarks.—Of twenty-three cases operated on by Eve with the double lithotome, four died, three of which were from the operation, two indirectly and one directly; and seventeen were well in two weeks after the operation.*

Operation of J. F. May, of Washington.—The patient, being etherized, was cut as in the operation of Dupuytren, and a large stone readily extracted. Its longest diameter was two inches and a fraction, its shortest diameter one and five-eighths of an inch, and its circumference five and five-eighths inches.

Remarks.—Among American surgeons, the bilateral operation was first performed by Ashmead, of Philadelphia, in 1832, and by Ogier, of Charleston, in 1835, since which there have been many who have advocated and practiced it, among whom may be mentioned Stevens, Hoffman, and Post, of New York; Warren, of Boston; Mussey, of Cincinnati; May, of Washington; Pancoast, of Philadelphia; Eve, of Nashville; Pope, of St. Louis; Dugas and Campbell, of Georgia, with many others; though several of them prefer the use either of a special instrument or of a probe-pointed bistoury to the lithotome of Dupuytren. My own experience, as gained upon the subject, corresponds entirely with this, as even with a lithotome, selected by the hands of Charriere, of Paris, I have found the blades to spring and yield to such an extent as to interfere with the accuracy of the section. The mode of operating described by Mussey is, therefore, preferable to that advised by Dupuytren.

As the incision of Dupuytren permits a very free dilatation of the perineal integuments, and also corresponds with the arch of the pubis through which a large calculus must pass, I do not think there is any material advantage gained in the size of the wound by the incision resorted to by Fergusson and Eve, while the central portion of it, except in very skillful hands, would expose an operator to much greater risk of wounding the bulb of the urethra than is the case in Dupuytren's operation. A median incision through the skin and perineal fascia, in the line of the raphe, will readily expose the bulb, though, of course, a skillful operator might expose it without wounding it.

The points of recommendation claimed for the bilateral operation over either of the others, are a more direct and free access to the bladder without injuring the vesical plexus of veins, as well as less risk of dividing important blood-vessels; but, on the other hand, the rectum is more exposed in the primary incisions, and perineal fistula, impotence, and a tendency to stricture near the prostatic portion of the urethra are said to be increased. Statistics alone can settle a question of this kind, though at present it is generally admitted that in cases of very large calculi, or in a case attended by anchylosis of the hip, as in that reported by Pope, of St. Louis, or in analogous difficulties, the bilateral is preferable to the lateral section. The lateral incision is, however, fully capable of removing a large stone, and I have extracted one by this method that weighed two ounces and seventeen grains, and was six inches in circumference. The increased fondness of American surgeons for the bilateral rather than the lateral operation, seems, however, to indicate that experience proves its special advantages, though fashion occasionally regulates surgery to a certain extent as it does less important subjects.

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* Report to Med. Association, 1852.

SECTION V.

THE MEDIAN OPERATION.

Lithotomy having at one period been the especial province of one family, or class of individuals, it is not surprising that various plans of accomplishing it should have been each highly lauded, and handed down as perfect from generation to generation. Among all these methods, that in which the perineum is incised in the median line, and the stone extracted by opening the urethra in the same direction—being the old operation of Sanctus Marianus, and hence sometimes called the "Marian operation"—would at first sight appear to be the safest. But this operation, though very ancient, has, in truth, but little to recommend it, except in the case of small calculi, or for the removal of foreign bodies, as a broken catheter, etc., from the bladder. It is now only referred to because some of its steps may occasionally be found useful in extracting such fragments of calculi as lodge and become fixed in the urethra, or for the removal of such pebbles as are developed in the prostate gland, and because it has within the last few years been revived, in a modified form, by Allarton, of England, and spoken of as his method. The operation of Giovanni di Romanis, as published in 1520, and since repeatedly modified, is as follows:—

Operation of Vacca Berlinghieri.—The patient being placed in the position for lithotomy, an incision is to be made in the median line of the perineum from the origin of the scrotum to the anterior border of the anus, so as to divide the skin, superficial fascia, and anterior fibres of the sphincter ani muscle, and lay bare the groove of a staff in the membranous portion, without exposing the bulb. The knife, or probe-pointed bistoury, being then passed along the groove of the staff into the bladder, the prostate is to be divided to the extent of four or five lines in a direction parallel with the median line.

Allarton's Operation.—Placing the patient in the position for lithotomy, introduce a deeply grooved convex staff into the bladder, give it in charge of an assistant, and push the left forefinger into the rectum until it distinctly feels the prostate gland. Then with a long, sharp-pointed straight bistoury, holding its edge toward the staff, puncture the perineum in the raphe, about three lines in front of the anus, and push it toward the membranous portion of the urethra, the forefinger in the rectum serving as a guide to prevent the wounding of the bowel. On puncturing the membranous portion of the urethra, elevate the handle of the bistoury so as to cut the perineum upward in its median line, and freely lay bare the convexity of the staff. Then, passing a ball probe along the staff into the bladder, withdraw the staff, and gradually pushing the left forefinger along the probe, dilate the prostatic portion of the urethra and neck of the bladder until the stone is felt; upon introducing the forceps, extract as before directed.

Remarks.—The advantages claimed for this operation are its safety, freedom from hemorrhage, and its easy execution; all which are admitted. But experience has shown that it is specially adapted only to small calculi, and it is doubtful whether such cases would not be better treated by means of lithotripsy. If the blade of a lithontriptic instrument or a catheter should be broken off in the bladder, or if a piece of slate-pencil or a pipe-stem should have been accidentally passed into the bladder, then the median operation, as modified by Allarton, may be advantageously resorted to.

§ 1.—Lithectasy.

The term **Lithectasy** has been employed to designate the modification of the median operation recently revived by Willis, of England.* In the operation of Romanis or Marianus, as advocated by Marceaux, or the major apparatus—so called from the number of instruments employed in its performance—the membranous portion of the urethra was opened by an incision made near to, but on the side of, the raphe; after which a probe was passed along the staff into the bladder, and then two conductors being passed along the probe, the prostate gland and neck of the bladder were forcibly dilated, or, perhaps, torn. As modified by Willis, this operation now consists in opening the membranous portion of the urethra by an incision in the line of the raphe above the anus. After thus opening the urethra, a sponge-tent, a piece of compressed sponge, a dried piece of carrot-root, as suggested by Guérin, of Bordeaux, or some similar dilator, is introduced, and the opening expanded, in twenty-four hours, sufficiently to admit the entrance of such forceps as will remove a small calculus.

Remarks.—This operation has but little to recommend it. The dilating process is slow and apt to be a serious source of irritation to the patient. Owing to the difficulty of accurately deciding on the size of a calculus, there is also the risk of having an opening which will not permit the stone to pass until the wound is further enlarged by the knife. It will, therefore, be but seldom adopted by any surgeon who is familiar with the performance of the ordinary lateral operation.

§ 2.—Recto-Vesical Lithotomy.

The idea of **opening the Bladder through the Rectum** was suggested as early as the sixteenth century, but appears to have fallen into disrepute until revived by Sanson, of Paris, in 1816. His method of operating was as follows:—

Sanson's Operation.†—The patient being placed in the position for lithotomy, introduce a staff with a large curve into the bladder, and have it held perpendicularly by an assistant. Then passing the left forefinger into the rectum, pass in on the finger a sharp-pointed bistoury, and, cutting from behind forward, divide the sphincter ani muscle and the lower anterior portion of the rectum so as to expose the prostate gland. On passing the forefinger into the wound behind the gland, feel the staff through the parietes of the rectum and bladder, and, puncturing the tissues, open the groove of the staff about one inch, when a gush of urine will follow, the prostate remaining undivided.

Remarks.—This operation was modified by Sleigh so as to divide the portion of the bladder bounded laterally by the vasa deferentia and the vesiculæ seminales—above by the cul-de-sac, or reflected portion of the peritoneum, and below or anteriorly, by the prostate gland and the union of the seminal tubes, without incising the sphincter ani muscle.

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* Willis on Stone. † Cooper's Surgical Dictionary, by Reese. N. Y., 1851.

Except in the case of an immense calculus which projected into the rectum, this operation can hardly be regarded as justifiable, the high operation, or that above the pubis, being preferable, if the stone cannot be crushed. In the few instances reported, death has frequently supervened, rectal fistulæ have followed, the feces have passed into the bladder, and the patients, after escaping peritonitis and the evils of fistulæ, have been unable to retain the urine in the bladder, owing to the division of the muscle of the vesical triangle. The operation has been so long regarded as obsolete, that it is difficult to understand how any surgeon should at the present day feel justified in repeating it in opposition to the well-known experience of Scarpa, Dupuytren, and other European surgeons, who soon expressed their dissatisfaction at the result of the cases operated on. It is only now mentioned to caution any who may be tempted, by its apparent novelty, against its repetition.

SECTION VI.

OF THE SUPRA-PUBIC OPERATION.

As the process of peritoneum which lines the abdominal muscles is reflected from above the pubis to the superior and posterior portions of the bladder, there is a space left anteriorly through which it is possible to open the bladder without incising the peritoneum, and it is at this point that the extraction of calculi by the supra-pubic or hypogastric operation has been occasionally practiced; though the majority of operators have preferred incising the perineum.

Operation of Sir Everard Home.—An incision being made four inches long, between the pyramidales muscle in the direction of the linea alba, the tissues were divided down to the tendon, which was then pierced close to the pubes, and divided by a probe-pointed bistoury to the extent of three inches, a portion of the origin of the pyramidales being detached so as to increase the size of the opening near the pubes. The forefinger being now passed in toward the pelvis, the fundus of the bladder was recognized, and a silver catheter, open at both ends, being carried into the urethra, its point could be felt pressing upon the fundus of the bladder. A stylet, which had been concealed in the catheter, being then forced through the coats of the bladder, was followed by the end of the catheter, and the stylet being withdrawn, the puncture in the bladder was enlarged sufficiently to admit two fingers, by means of the probe-pointed bistoury. The stone being now felt by one finger, while the superior fundus of the bladder was held up by the other, a pair of forceps, with a net attached, should be passed down into the bladder, and the stone directed into it and retained there by the finger till extracted. A slip of linen being then introduced into the bladder, one end was allowed to hang out of the wound, and the edges of the latter closed by adhesive plaster, a catheter being kept in the urethra in order to draw off the urine.

Remarks.—This operation, which was assigned to Franco, in 1561, and afterward practiced by Rousset in 1581, has seldom been deemed advisable by surgeons, except for the removal of very large calculi, or in consequence of a diseased prostate.

In the United States, it was first performed by Gibson, of Philadelphia, but it has since been repeated by Carpenter, Van Valzah, and George M'Clellan, of Pennsylvania.* In a case reported by Wm. D. Johnson, of

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* Gibson, vol. ii. p. 260. Gross, p. 500.

Georgia, the lateral operation was first performed, and then the supra-pubic, in consequence of the great size of the calculus, its weight being nearly six ounces, its longitudinal circumference seven inches, and its lateral circumference five inches and three-quarters.* The chief recommendation of the high operation appears to be the safety arising from the absence of hemorrhage; but this is more than counterbalanced by the risks of peritonitis, urinary infiltration, and abscesses, and it should only be resorted to in cases of very large calculi that cannot be crushed by instruments introduced into the bladder through the lateral or bilateral incision; cases that can seldom be presented to a skillful operator.

§ 1.—The Quadrilateral Operation.

Vidal du Cassis having suggested the incision of the prostate in several directions, like the radii of a circle, so as to admit of the greater distention of the opening, his mode of operating has been designated as the **quadrilateral operation.** Except in the very rare instances of enormous calculi, such incisions must, however, be unnecessary, and, when required, could be easily added to any of the other plans of operating, though originally suggested in connection with the bilateral operation.

SECTION VII.

GENERAL REMARKS ON PERINEAL LITHOTOMY.

In the consideration of the different methods of performing perineal lithotomy, little has been said in reference to the mode of extracting the stone; in relation to the accidents likely to occur during the operation; or in respect to the dressing and after-treatment, all of which demand special consideration.

§ 1.—Extraction of the Stone.

In extracting a calculus, after the bladder has been opened by either the lateral or bilateral methods, much care and skill are necessary, this part of the operation being, in many instances, the most difficult and tedious step of the proceeding. The wound may apparently be free, and the primary incisions rapidly and neatly made, with every appearance of a speedy termination to the operation; and yet the mere extraction of the stone through the wound will occupy more time than would suffice for several incisions. In order promptly to accomplish the removal of the stone, the operator should, therefore, first endeavor to learn its position and mode of presentation, and in this he may be materially assisted by recalling the shape of the bladder, its relations to surrounding parts, and the tendency of the stone to gravitate to the most depending point. Most calculi, especially when single, lie at the posterior inferior part or the bas-fond of the bladder, in consequence of their weight, or because the contraction of the muscular coat forces them to occupy such a position as is most favorable to the escape of the urine by the urethra, presenting, therefore, their longest diameter longitudinally, and their flattened side downward. In order to seize a stone thus placed, the curved forceps should be introduced, so that the convexity of their blades may correspond with the posterior angle of the wound, their handles being at the same time elevated sufficiently to place their points in the lowest portion of the bladder, Plate LIV. Fig. 5. When the thickness of the perineum permits it, the left index finger should also be made to depress the posterior angle of the wound, especially in the bladder, and serve as a guide for the forceps; but as in a large deep adult perineum this is sometimes impossible, the operator will be compelled to rely upon the knowledge gained in his previous examinations for the probable position of the calculus. After touching the stone with the points of the forceps, the rings of the latter should be seized between the thumb and fingers of each hand, the blades cautiously expanded, and then by a half turn to the left, made to scoop up or seize the calculus as it is forced into the grasp of the instrument by its own weight, or by the contractions of the bladder. If, however, this should not be the case, the operator may gently expand and close the blades of the instrument, giving them at the same time a gentle lateral and up-and-down motion, so as to sweep the bladder by their smooth and external surfaces, until the stone is brought within their grasp. When seized, the left forefinger should be slipped along the blades, so as to feel if the short diameter of the stone is parallel with the transverse diameter of the wound, and being satisfied of this, the calculus, if large, may be extracted by pulling it gently but steadily toward the operator, it being at the same time moved laterally, as well as up and down, in order to favor the dilatation of the wound. The use of Barton's forceps—Plate LIII. Fig. 9—will materially facilitate the extraction of the stone, as the fenestra diminish the space occupied by the thickness of the instrument; but if the calculus is of the ordinary size, and the incisions sufficiently large, little difficulty will be experienced from the latter source. In many instances, the incision in the prostate has not been sufficiently large, or the inferior angle of the wound or the opening in the skin is too narrow; and when this is the case, much may be done by persevering and gradual dilatation of the part, or by enlarging the angle of the wound with the bistoury. When the size of the stone forbids all hope of its extraction entire, then it should be crushed by Earle's forceps, Plate LIII. Fig. 14, or by Heurteloup's lithontripteur, and extracted piecemeal, the fragments being removed by washing out the bladder with barley-water.

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* Southern Med. and Surg. Journ., vol. vii. p. 393, 1851.

The Scoop is an instrument that may prove serviceable in cases where the size of the stone forbids the hope of introducing the additional thickness of the forceps, or in cases of numerous calculi, or in that of fragments of a calculus. Or it may be resorted to for the removal of such calculous concretions as are occasionally found upon parts of the bladder, and which require to be peeled off. Whenever the attempt is made to remove a calculus by the scoop alone, the point of the forefinger of one hand should be placed against the stone to steady it in the hollow of the instrument, Plate LIV. Fig. 6.

After removing a calculus by any instrument, the finger should be again introduced into the bladder, and carefully passed around it in order to ascertain whether some particles have not been left. Should any be found, it will be better to wash them out by freely injecting barley-water than to attempt to seize them with forceps, or to remove them with the scoop. The injection will also prove useful by removing clots from the part.

If the stone should be *encysted*, or adherent, the steps to be pursued will depend mainly upon the manner in which it is attached, and on the judgment of the operator. Sometimes the attachment is owing to folds of the bladder being introduced into asperities in the calculus, and these may be often overcome by passing the finger gently round, and hooking out the stone; or a process from the stone may have entered a dilated ureter, or be placed in an abnormal pouch in the bladder. To relieve either of these latter attachments, it is usually necessary to exercise judicious traction upon the main portion of the stone; though the process of the mucous membrane may require to be ruptured with the finger, or, if it is a simple band, to be divided by the knife, in order to free it; but the necessity for the latter is very rare, and it should never be resorted to until every other means have failed.

§ 2.—Accidents connected with Lithotomy.

An accident that occasionally complicates the operation of lithotomy, even in careful hands, is hemorrhage, though, under ordinary circumstances, this is not sufficiently severe to demand active treatment. A wound of the rectum may happen, but it can generally only be regarded as evidence of the incompetency of the operator.

Hemorrhage may arise from several points connected with the incisions in lithotomy: 1st, it may come from the perineal arteries; 2d, from the vesical plexus of veins; and, 3d, from the internal pudic; the latter being, however, much less frequently wounded than an inexperienced surgeon might suppose, as it lies too near the ascending ramus of the ischium to be in the way of any ordinary incision. When, however, the hemorrhage from any point is sufficient to demand treatment, it may be arrested either by the application of the ligature or by pressure.

I. **Ligature in Hemorrhage.**—The ligation of the smaller perineal arteries does not differ in any respect from the ligation of other vessels, the open vessel being seized with a tenaculum, and then tied with the silk ligature. But if by any accident—and it is rare—the main trunk of the internal pudic artery be divided, the hemorrhage will be more troublesome, though it may be promptly controlled simply by compressing the artery with the finger against the ramus of the ischium until a ligature can be thrown around it. To accomplish the latter, few instruments will be found more serviceable than that resorted to by Physick under similar circumstances, and hence named Physick's forceps and needle, Plate III. Fig. 5. The needle being passed beneath the trunk of the artery, the ligature is carried around the vessel, and made to compress it by inclosing a portion of the flesh near the vessel.*

II. **Plugging in Hemorrhage.**—From the varicose condition of the vesical plexus, especially in old men, a general hemorrhage or oozing is sometimes seen from the wound, without its being possible for the surgeon to detect any point suitable for a ligature. Under these circumstances, compression is the only alternative, and may be readily accomplished by passing a large catheter into the bladder through the wound, and then packing the latter full of lint or charpie, the escape of the urine through the catheter preventing distention of the wound in the neck of the bladder, while the lint at its sides favors the formation of the clots which tend to close the vessels. After the lapse of three days, or when there is evidence of suppuration in the wound, this lint should be carefully withdrawn, lest it interfere with the cicatrization.

III. **Wound of the Rectum.**—From want of attention to the entire evacuation of the bowel before the operation, or from the great dilatation of the prominent pouch or enlargement generally noted near the middle of the gut, or from the surgeon wandering from the staff in the prosecution of his incisions, the rectum has been perforated on its anterior surface, and the after-treatment of the case complicated with the production of a rectal fistula. Although such a fistula is a source of annoyance, adds an unnecessary risk to the chances of the patient, and is, I think, positive proof of the want of skill in the operator, its evils have been over-estimated by some writers, as, unless the wound is large, it is usually readily amenable to treatment. In the simple case of a small puncture of the gut, which is detected at the time or soon after the operation, the best mode of obviating it is to evacuate the contents of the bowel, give a large anodyne enema to keep the parts at perfect rest, and then, by means of the catheter passed into the bladder through the wound, prevent urinary infiltration of the surrounding structures. In more extended injuries, the entire division of the sphincter ani muscle, as in rectal fistula, together with the free use of anodynes, by allowing the gut to collapse, will favor the union of the incision. But even where a recto-vesical fistula has resulted, cauterization and perfect rest have often sufficed to heal it. In two instances, where I have seen this accident occur in the operations of rapid surgeons, little or no treatment was requisite, the patients recovering without being aware of the occurrence.

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* Dorsey's Surgery, vol. ii. p. 190.

SECTION VIII.

AFTER-TREATMENT IN PERINEAL LITHOTOMY.

The importance of a judicious **after-treatment** in every operation has been, perhaps, sufficiently insisted on in the previous pages, yet the knowledge of a case in which an inexperienced operator, after succeeding in extracting a calculus by lithotomy, felt compelled to seek directions respecting the proper steps of the after-treatment, induces me to give it in this operation such extra attention as my limits will permit.

§ 1.—Putting to Bed.

After the completion of the operation, including the arrest of hemorrhage, the first point to decide upon will be the dressing. In most instances nothing is required except rest, as the wound is intended to heal by granulation. According to some surgeons, certain advantages are to be obtained from tying the patient's knees together, and keeping him upon his left side, so as to favor the union of the edges of the wound, and the escape of the urine without infiltration of the surrounding parts. Others, again, place a large catheter in the bladder by passing it through the wound, fastening it in position by a strip of adhesive plaster, which is attached to the perineum, so that the catheter, by leading the urine off to a saucer, may keep the patient dry. But the use of this catheter is liable to the serious objection that it prevents union by the first intention of the neck of the bladder, this union having been the fortunate result in two of Physick's operations.* When the catheter is retained in this way more than a few days, it is also very apt to lead to the establishment of perineal fistula. For many years, I have been accustomed to have patients removed directly from the operating table to the bed without any dressing, the bed being kept dry by the strict attention of the nurse, and the removal of the cloths placed beneath the wound as soon as they were wet. I would therefore urge the advantages of preparing the bed and patient as follows: Place a piece of oil-cloth upon a good elastic hair mat-

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* Dorsey's Surgery, vol. ii. p. 191.

PLATE LVI.

INSTRUMENTS EMPLOYED IN THE OPERATIONS OF LITHOTOMY AND LITHOTRIPSY.

Fig. 1. The Sound employed in detecting the presence of a stone in the bladder of the male. 1. Its smooth handle. 2. A curve of a medium size.
Kolbè's pattern.

Fig. 2. Staff employed in operating for lithotomy on the female.
Kolbè's pattern.

Figs. 3, 4, 5, 6. Staves of different sizes and curves, so as to be adapted to the urethra of different patients in the ordinary lateral operation for lithotomy. The handles should be broad and well serrated, so as to furnish a firm hold, and prevent the groove slipping or turning from the position in which it is wished to be held during the perineal incisions. *Kolbè's pattern.*

Fig. 7. Jacobson's instrument for crushing a calculus in the bladder. 1. The articulated loop which holds and crushes the stone when it is caught in the grasp of the instrument. 2. The screw which closes and expands the loop.
Kolbè's pattern.

Fig. 8. Heurteloup's Lithontripteur. 1. The female blade. 2. The male blade. 3. The vice in which the screw works in crushing the stone. 4. The screw. *Kolbè's pattern.*

Fig. 9. A Litholabe for extracting fragments of a calculus or pebbles from the neck of the bladder. *Kolbè's pattern.*

Fig. 10. Leroy d'Etiolles's Articulated Scoop for the removal of fragments which lodge in the urethra. *Kolbè's pattern.*

Plate 56

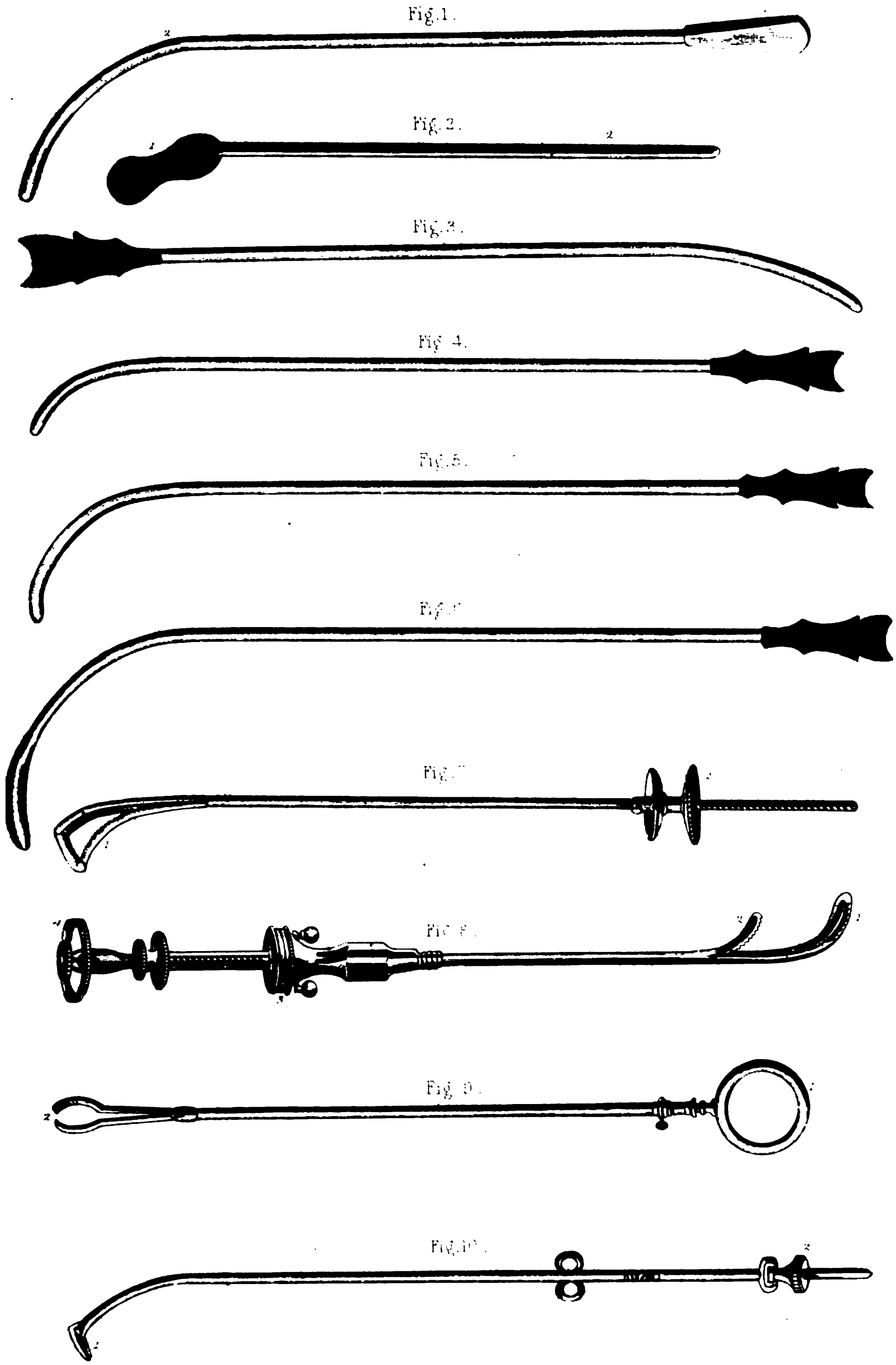
Fig. 1.
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Fig. 2.
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2
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
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Fig. 8.
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Fig. 9.
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Fig. 10.
2
1

tress at a point corresponding with the patient's hips; place over this the ordinary sheet; and place upon this, transversely, the end of another sheet folded in four lengthwise, so that as soon as one part is wet by the urine, it may be drawn away and a dry part substituted. The position of the patient "upon the left side, with the knees drawn up," has long been a standing rule, and so religiously observed by some that I have seen the great trochanter and crest of the ileum almost ready to come through the skin from the continued pressure, the patient being compelled to use large doses of opiates in order to obtain sleep. In numerous cases in which I have operated, I have never paid much attention to the position of the patient after the first twenty-four hours, as the lymph effused upon the edges of the wound during this period was generally sufficient to prevent smarting from the urine passing over it, while as soon as any amount of urine collected in the bladder, the patient invariably turned himself so as to favor its evacuation.

§ 2.—Treatment of the Wound.

The urine escaping from the wound by the lowest angle, occasionally induces some little cutaneous irritation, which, if it becomes an annoyance, should be obviated by anointing the part with mild cerate. After two or four days the lips of the wound usually become tumid, and present signs of inflammation. In most instances, this is only indicative of the efforts of nature to close the perineum, and should not, therefore, be interfered with unless excessive, when warm, moist cloths, frequently changed, will suffice for its regulation. If calculous matter forms around or in the wound, it should be washed away with a stream of water from a syringe, or loosened by the action of a weak solution of hydrochloric acid.

The bowels also should be kept at perfect rest by anodyne enemata until the fourth day after the operation, when the administration of a mild laxative, as rhubarb or citrate of magnesia, will be serviceable. If, on the escape of urine through the penis, the perineal wound does not heal, a catheter may be placed in the urethra, and the union of the wound facilitated by the use of caustic or by means of pressure.

§ 3.—Constitutional Treatment.

As a general rule, the constitutional treatment after the operation for lithotomy should be antiphlogistic, though strict attention should also be given to the previous habits of the patient. If the patient is an old man, good diet, or even stimulants, will frequently be demanded, and tardy healing of the wound will sometimes be prevented by such an increase of diet.

But among the most important of the steps connected with the constitutional after-treatment of lithotomy is the removal, if possible, of the calculous diathesis, as it is not sufficient for the cure of the patient that the surgeon should have removed the stone; a change in the character of the urine must also be induced. It is therefore advisable, in every case, to test the urine, both before and after the operation, by litmus paper, the microscope, or similar means, until its peculiar characters are known, and then to obviate the unhealthy action of the kidneys by acids, alkalies, diet, or other appropriate means of treatment.

SECTION IX.

GENERAL ESTIMATE OF THE VALUE OF THE DIFFERENT METHODS OF OPERATING FOR LITHOTOMY.

After what has been said in the preceding sections, of the special advantages of the different modes of operating, there is but little that is new to offer in a general estimate of the whole of them; and yet such a summary is not without its value.

Statistics of the Lateral Operation.—The statistics of lithotomy, though presenting the result of a large number of cases, do not offer a perfectly reliable account, because, in many instances, nothing is said of the peculiarities of the case, the age of the patient, or other incidents which must exert a very important influence upon an opinion. Yet, as such statistics have a certain value, and are at present the only data upon which an inexperienced surgeon could form even an approach to an estimate of the risks to which a patient is exposed by the operation, they are presented as obtained from the sources mentioned.

	Cases.	Deaths.
Dudley, of Kentucky[*]	207	6
Pennsylvania Hospital, Philadelphia[*]	83	10
Gardner, of Kentucky[†]	15	1
Davis, of Ohio[†]	72	6
Eve, of Georgia[†]	2	1
Bush, of Kentucky[†]	5	0
Gibson, of Philadelphia[‡]	50	6
Mettauer, of Virginia[§]	73	2
John C. Warren, of Boston[§]	30	2
Henry H. Smith, of Philadelphia	13	0
March, of Albany[§]	7	0
	557	34
Smith, of Bristol, England, reports for Great Britain	354	79

The mortality in Great Britain, after the operation, including children, is about 1 in 4. The mortality in the United States, including children, is about 1 in 15. Showing that the operation of lithotomy has been nearly four times as successful in the United States as in Great Britain.

Statistics of the Bilateral Operation.—After examining the various tables, and separating these from the cases specially mentioned as operated on by the bilateral section, the following result has been obtained:—

	Cases.	Deaths.
Paul F. Eve, of Georgia[‖]	25	4 specified.[††]
Spencer, of Virginia[‖].	16	2 "
Mussey, of Cincinnati[¶]	18	0 "
Hôtel-Dieu[**]	26	0 "
Dupuytren[*]	70	6 "
Warren, of Boston[*]	3	0 "
	158	12

Or a mortality of about 8 per cent.

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[*] Trans. Am. Med. Assoc., vol. iv. p. 273, 1851.

[†] Ibid., p. 274.

[‡] Gross on Urinary Diseases, p. 470.

[§] Trans. Am. Med. Assoc., vol. i. p. 161.

[‖] Ibid., vol. iv. p. 274, 1851, and again in a report, April, 1852.

[¶] Ibid., vol. ii. p. 226, 1849.

[**] Velpeau, Op. Surg., by Mott, vol. iii. p. 918.

[††] Of these, one died directly from the operation.

In the twenty-five cases operated on by Eve, two were females, and in no case did he know either of a fistula in perineo or of a stone having ensued upon the operation.

In a recent notice of the result of lithotomy in the London hospitals, the statistics are as follows:—

Lithotomy.—Of 186 cases operated on in the metropolitan hospitals, 146 recovered and 40 died.

Ages.—137 were under 20, of whom 123 recovered and 14 died; 49 were adults, of whom 23 recovered and 26 died.

Causes of Death.—Renal diseases, 14; hemorrhage, 4; pyemia, 4; peritonitis, 4; shock of operation, 2; extravasation of urine, 2; abscesses about the bladder, 2; wounds of fundus of bladder by the knife, 2; exhaustion, 1; convulsions, 1; cystitis, 1; bronchitis, 1.*

Of 152 cases in the Glasgow Royal Infirmary, there were 19 deaths:—

	Cases.	Deaths.
Under 5 years	50	3
" 10 "	34	2
" 15 "	11	1
" 20 "	14	5
" 30 "	15	5
" 50 "	14	0
Over 50 "	14	3
	152	19

Proportion of deaths to cases in patients under fifteen years, 1 to 15·83; over fifteen years, 1 to 4·384. Proportion in whole number of cases, 1 to 6·913. Of these, 52 cases were operated on by Buchanan's rectangular method, with 5 deaths, or 1 to 10·1.†

Of 175 cases operated on in the provincial hospitals, 22 died.

Causes of Death.—Peritonitis, 6; abscesses about the bladder, 4; hemorrhage, 3; pyemia, 2; shock of operation, 2; renal diseases, 2; extravasation of urine, 2; exhaustion, 2; broncho-pneumonia, 1. Of the 175 cases, there were, under five years old, 41 cases, and 5 died; between five and ten years old, 55 cases, and 1 died.

Stone in Females.—Twenty-four cases, 16 metropolitan and 8 provincial. Of 24 cases, 2 died; both these deaths were cases of adults.‡

Statistics of Supra-pubic Lithotomy.—A brief account of the cases operated on shows that this operation has obtained a sufficiently large success to justify its repetition where other means are not admissible. Out of twenty-five cases which I have collected, from various sources, twenty-one have been cured and four died, thus presenting a mortality of about one in five.

Great allowance must, however, be made for the results as shown in all these tables. In several instances, the deaths have not been specified; in others, the surgeon has relied upon his recollection, and supposed that he has operated on about fifty cases with a moderate number of deaths; and in the statistics furnished under the head of the lateral operation, it is not always certain that the lateral method was the one employed. I have, however, examined the statements closely, and endeavored to obtain a correct result, and my conclusion is that the only point that can be depended on in the above tables is, that out of 715 cases, 541 were cut by the lateral, 149 cases by the bilateral, and 25 cases by the hypogastric operation, thus showing a decided preference among surgeons in favor of the lateral operation.

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* Med. Times and Gaz. † Glasgow Med. Journ. ‡ Med. Times and Gaz.

CHAPTER V.

LITHOTRIPSY, OR CRUSHING OF STONE IN THE BLADDER.

THE removal of a calculus from the bladder by the introduction of crushing instruments capable of reducing its particles to such a size as would pass out by the urethra, is an operation of great antiquity, having been spoken of by Ammonius about 110 B.C.,* though it appears to have been lost sight of, until again brought forward through the efforts of Civiale, of Paris, about 1822. Like most other novel operations, the progress of lithotripsy was at first retarded by the great number of instruments supposed to be necessary for its performance. Enlightened by the experience of the distinguished European surgeons who seconded Civiale's efforts, and simplified the method very considerably, the operation has now been brought to such perfection that any surgeon can accomplish it, if a sufficiently dextrous manipulator; gentleness, a delicate sense of touch, and a light hand, aided by a good crushing instrument, being the points most essential to its performance at the present period.

In the United States the operation of lithotripsy has been practiced to a considerable extent, by the employment of Heurteloup's instrument as well as with that of Jacobson.

The first operation was performed by Depeyre, of New York, in 1830; the second by Alban G. Smith, then of Kentucky, in 1831; and soon afterward by Randolph, of Philadelphia; Spencer, of Virginia; Uttery, of Rhode Island; Gibson, of Philadelphia; N. R. Smith, of Baltimore; and subsequently by many others. To Randolph, of Philadelphia, the American profession are, however, chiefly indebted for the early and progressive cultivation of lithotripsy in this country; his name being extensively known in connection with his labors on this subject. Few surgeons in the United States have repeated the operation more frequently than he did upon patients of all ages, and few have been more distinguished in this department of surgery, either for the beauty of their manipulation, or for the success which attended their operations. In every case he was remarkable for the care he exercised in the preparation of his patients, as well as for the brevity of "the sittings."

Without entering into the general history of the progress of the operation, or spending time in the description of the multifarious instruments heretofore devised and employed, this account will be limited to the operation as performed with the "lithontripteur," or "stone-crusher," of Heurteloup, this being the instrument now most frequently resorted to.

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* Smith's Dict. Greek and Roman Antiquities, art. *Chirurgie.*

SECTION I.

PRELIMINARY TREATMENT NECESSARY IN LITHOTRIPSY.

As the principal danger in the operation of lithotripsy arises from the production of crystals, it is of the utmost importance that every means be employed to prevent it. The preliminary treatment will therefore often be the chief source of success, and it should be pursued according to the following plan: After giving attention to the condition of each organ, special efforts should be made to remove the irritability of the bladder by the free use of the warm hip-bath, by anodyne enemata, and especially by the use of alkalies, as they, by depositing on and equalizing the surface of a rough stone, often counteract one great source of irritation. When these constitutional remedies have induced a less irritable condition, a local preparatory treatment should be commenced, especially the frequent introduction of bougies, so as to dilate the urethra gradually, and accustom the parts to the passage of an instrument. By perseverance in the daily use of a bougie for about eight days—allowing it to remain in the bladder for a half hour or hour, according to the irritation it causes, care being always taken to remove it if the patient complains much of pain—and gradually augmenting its size, the urethra may be prepared to receive the largest lithontriptic instrument not only without pain, but without much irritation. The preparation of a narrow bed or table of a convenient height, some tepid water, a little oil, and a good instrument, complete the preliminary measures.

The selection of the lithontripteur is a matter of the greatest consequence, and unless the instrument is of the finest temper and finish, it should never be used. I have been accustomed to test these qualities by crushing a moderate-sized tamarind stone in the instrument before attempting to break a calculus. The danger from an imperfect instrument is, however, not in its breaking, so much as in its bending or spreading at the point, so as to prevent its retraction. In two instances, in the hands of Geo. M'Clellan, of Philadelphia, the male blade of Heurteloup's instrument was broken short off in the bladder, and yet subsequently voided with the urine and sand; but when, from want of temper, the female blade is expanded, or either blade is twisted or bent, the withdrawal of the instrument may become impossible without a serious laceration of the neck of the bladder and urethra.

SECTION II.

OPERATION OF LITHOTRIPSY.

Having in former years aided in carrying out the plan of treatment directed by Randolph, of Philadelphia, who was eminently accomplished as an operator in this department of surgery, I have selected his method as that which may be advantageously followed; not that it presents anything peculiar, but because it is sanctioned by the experience of one of the earliest and most frequent operators in the United States, and has since been confirmed by me in numerous operations on my own patients.

Operation of Randolph.—The patient, after a careful preliminary treatment, being placed upon his back on a narrow table, covered with blankets, and with a pillow under the hips, bring the latter to the end of the table, elevate the head and shoulders slightly by pillows, and support the feet on

PLATE LVII.

OPERATIONS FOR THE REMOVAL OF STONE FROM THE BLADDER.

Fig. 1. Hypogastric Operation for Lithotomy. An incision having been made in the linea alba, and the bladder opened, the left forefinger of the surgeon is seen holding up the superior angle of the wound. While an assistant separates the left side by a blunt hook, the right hand of the surgeon elevates the calculus from the bas-fond of the bladder by means of the scoop. 1. Left hand of the surgeon. 2. His right hand elevating the stone.

After Bourgery and Jacob.

Fig. 2. The scoop which thus supports the stone, and prevents its again falling into the bladder, being now held by an assistant, the surgeon seizes it in the forceps with both hands, and is seen in the act of extracting it. 1, 1. Hands of the surgeon. 2. Assistant holding the stone near the wound, so that the forceps can readily seize it. *After Bourgery and Jacob.*

Fig. 3. A view of the Operation of Lithotripsy. A section of the parts around the pelvis shows the position of the patient, and the manner in which the stone is seized and held by the lithontripteur of Heurteloup.

After Bourgery and Jacob.

Fig. 4. Another view of the same operation, showing the position of the fragments in the bladder and the mode of seizing them, after the stone has been crushed two or three times. *After Bourgery and Jacob.*

Fig. 5. Extraction of a fragment of a calculus from the prostatic portion of the urethra by means of the articulated scoop of Leroy d'Etiolles. The instrument is introduced as a straight sound, gradually passed behind the fragment, and then its end made to turn up at a right angle with its stem by means of a screw concealed in its shaft. 1. Handle of the instrument. 2. Its articulated point. 3. Fragment as held by it. 4. Prostate gland.

After Bourgery and Jacob.

Plate [illegible]

Fig. 1.

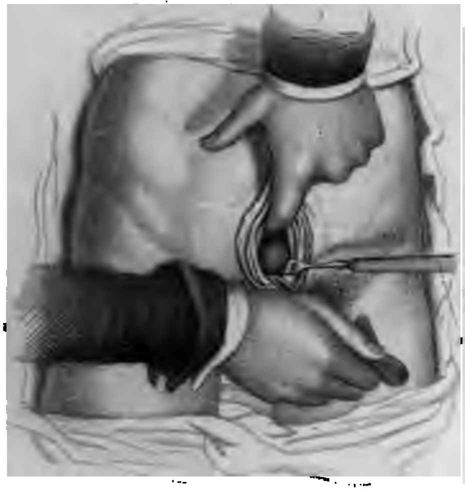


Fig. 2.

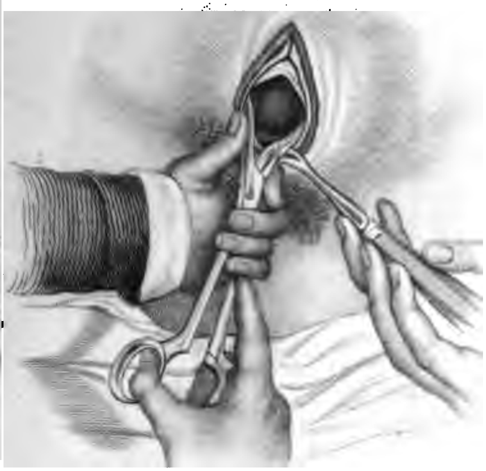
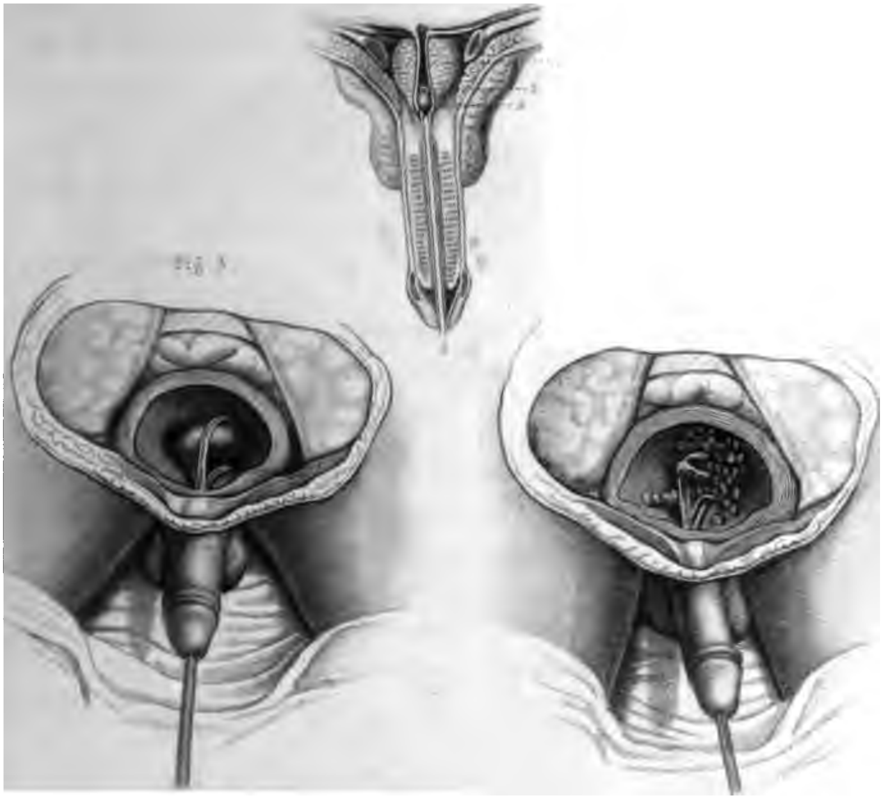


Fig. 3.



chairs, so that the knees may be wide apart. If the urine has now been retained, the lithontripteur may be immediately passed into the bladder in the same manner as the catheter, and with quite as much ease by a practiced hand; but if the urine has escaped, a silver catheter should be first passed, and tepid water injected into the bladder until it is partially distended, when the lithontripteur being gently introduced, its blades may be cautiously expanded and carried from before backward, or from right to left, or from behind forward, or from left to right, according to the position of the stone, the manipulation of a few seconds usually enabling the operator to catch it, Plate LVII. Fig. 3, though sometimes it apparently falls into the grasp of the instrument as soon as the latter is expanded in the bladder, and before the instrument is carried to any extent laterally. After seizing the stone, and moving it a little in the bladder so as to be sure that no portion of the mucous coat is included in the grasp of the instrument, close the blades by turning the screw with the hand, and thus break the stone; after which another part may be seized and broken. If the patient does not complain, it may now be seized a third time, Plate LVII. Fig. 4, after which the instrument should be gently tapped and moved about, in order to free it of the fragments, when the blades should be perfectly closed, and the instrument withdrawn from the urethra. The "sitting" may sometimes last only about five minutes, but seldom over twenty, even when it causes the patient no pain.

After-Treatment.—The patient, if comfortable, should now be kept on a light diet; but, if in pain, employ a hip-bath, with an enema of sixty drops of laudanum in a little thin starch, or a dose of Dover's powder, when if, after the lapse of from three to five days, no constitutional or local irritation forbids it, the operation may be repeated.

After crushing a stone, it sometimes happens that a fragment, in being voided, lodges and becomes fixed in the urethra, and this is usually the most troublesome part of the after-treatment. If arrested near the neck of the bladder, the better plan is to push it back into the bladder by means of a sound; but when it is near the fossa navicularis, it may become necessary to dilate the orifice of the urethra, and remove the fragment, if possible, with fine forceps. Should it, however, be further back, an effort may be made to draw it out by means of Leroy's scoop, Plate LVI. Fig. 10; or, if fast in the spongy portion of the urethra, by cutting down and extracting it through the opening, Plate LI. Fig 5.

Remarks.—In operating for lithotripsy, much will depend on the manual skill of the operator, as well as on his accurate knowledge of the anatomy of the structure operated on. In order to obtain the first, the young surgeon will find it very useful to practice upon stones introduced into the bladder of a subject, or to place them in a moderately soft buckskin bag, lay the latter upon a pillow, and then with closed eyes endeavor to catch the stone without inclosing also a portion of the buckskin. But although the operation of lithotripsy may thus be made to appear an apparently simple one, it is only so when practice has rendered the operator dextrous. In the hands of Civiale and Randolph, I have seen a patient continue in conversation with a smile upon his face during the whole sitting, while other operators have given rise to the most intense suffering by their heavy, clumsy, and thick-fisted manipulations. Since the introduction of anæsthetic agents, it has been thought that all pain from the operation could be avoided, and yet the dangers not increased; and such, I think, is truly the case; because, when the bladder is freely distended by the water previously injected, and the surgeon is a practiced operator, the use of the anæsthetic will not only prevent any suffering, but facilitate the operation by preventing straining. To such a surgeon the sense of touch, and that mental perception which enables him to know by his fingers exactly where the point of the instrument is in the bladder, will prevent any injury to the coats of the latter. But, under other circumstances, and in the hands of those who can only imagine what they are doing, the use of anæsthetics will be attended by much danger, as the cries of the patient will be the only proof that can be offered of the coats of the badder being injured; in other words, anæsthetics will facilitate the operation of lithotripsy in most instances, though it may also lead to most serious accidents. In the primary operations of young surgeons, it will certainly be safer for them to omit it.

SECTION III.

CASES ADAPTED TO THE OPERATION OF LITHOTRIPSY.

The claims of lithotripsy and its advantages over the operation of lithotomy is a subject that has engaged considerable attention at different periods since the early efforts of Civiale, and been discussed with a fervor that has shown the strength of individual predilection rather than the real merit of the question. It is sufficient evidence of the prejudice that has sometimes been exhibited in the expression of opinions on this subject, to know that very few surgeons, who prided themselves on their dexterity as lithotomists, have ever practiced or advocated lithotripsy; while some of those who excelled in lithotripsy, as warmly designated lithotomy "as a barbarous operation," etc.

Such a result being very frequently the consequence of the enthusiasm and reaction observed in all new movements, it will answer my present purpose merely to allude to it, as a caution to the young reader against allowing himself to be influenced by the authority of any name, no matter how high it may stand in surgical repute, and induce him to pursue the more judicious and eclectic system of selecting for his patient either lithotomy or lithotripsy, in accordance with the following general ideas:—.

1st. A sound condition of the urethra and bladder, as well as a good constitution, is essential to the success of lithotripsy.

2d. Very soft and phosphatic stones are the best for lithotripsy.

3d. Hard and rough calculi the best for lithotomy; because even, if crushed, the fragments will prove a source of irritation both to the bladder and urethra.

4th. Lithotomy will do better than lithotripsy in emaciated, nervous, and dyspeptic patients; though these, of course, are not promising cases for any operation.

5th. Lithotripsy is applicable especially to the young and middle-aged—the diseases of the prostate, and the condition of the bladder consequent on it, rendering the success of the operation doubtful, as a general rule, in old age.

6th. Lithotomy, if judiciously performed, will afford a better chance of success than lithotripsy, in cases attended by symptoms of vesical catarrh, etc.

But in every case of lithotripsy, let it be remembered that the preliminary and after-treatment are quite as important in the result as the operation itself. Rigors and fever, retention of urine, and cystitis, are among the results of lithotripsy in many instances, and a high degree of skill is necessary to protect the patient from the effects of this condition of the system. Both the preliminary and after-treatment are so essential to the success of the operation that it is difficult to decide between them; but, if there is a difference, I should assign the greater value to the preliminary treatment. To operate for lithotripsy without the most careful preparation of the patient's general health, is certainly indicative either of ignorance or of the indifference of the operator to the result of the operation.

SECTION IV.

LITHOLIBY.

Litholiby—*λιθος*, stone, *θλιβω*, to crush—is the term recently adopted by Denamiel, of France, to express an operation in which a stone is crushed as it lies in the vesical triangle, by means of an instrument introduced into the bladder on one side, and the forefinger in the rectum on the other, a sound in the bladder serving as a point of support. As he expresses great confidence in the disintegrating qualities of alkaline fluids, he makes their administration precede the operation. As the distance from the perineum to the neck of the bladder is usually two and a quarter inches, though it may vary from one to four, the prostate and neck of the bladder are so slightly separated from the rectum that any hard body in the bladder may readily be felt by a finger in the rectum. He therefore operates as follows:—

Denamiel's Operation.—The bladder being moderately distended, place the patient in the horizontal posture upon the edge of a firm bed, the thighs being separated and raised, and the feet resting on chairs; then, introducing the left fore and middle finger into the rectum, feel the stone, and, having found its position, pass in a curved sound grooved on its convexity, so that it may readily hold the stone, and, pressing the stone firmly against the sound by means of the fingers in the rectum, crush it thoroughly by directing the pressure to the right and left. If the calculus is very soft, Denamiel states it may thus be readily crushed; but if it is hard, several sittings, and the free use of alkaline fluids to favor its disintegration, will be required. Warm water should also be freely injected into the bladder after each attempt at crushing, in order to remove the particles.*

Remarks.—Of this operation I have no personal knowledge, nor am I aware that it has ever been repeated either in Europe or the United States; without further data I should mistrust it: 1st, because it is well known that the supposed disintegration of calculi by the use of alkalies is only the saturation of the acid constituents of the urine, which are then voided in the state of gravel, but which do not include any portions of a former stone; and 2d, because any compression that could be attempted upon a stone of even moderate firmness would necessarily bruise both the blader and rectum.

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* Med. News, p. 147. From Lond. Med. Times, 1853.

CHAPTER VI.

DISORDERS OF, AND OPERATIONS ON, THE FEMALE GENITO-URINARY ORGANS.

SECTION I.

SURGICAL ANATOMY OF THE FEMALE PERINEUM.

THE **Female Perineum** embraces a region that has been variously described by authors, some including in its boundaries most of the external organs of generation, and carrying it, as in the male, from the pubis to the coccyx; while others define it as the portion between the anus and vagina. For surgical purposes, the former is the most useful, though the changes produced in delivery are chiefly limited to the latter. Without entering upon all the details of this structure, it may suffice, at present, to allude briefly to such portions as are concerned in surgical operations.

The surgical relations of the Vulva require no other reference than the mention of the fact that the areolar tissue is here freely developed, and that cysts, abscesses, or wounds of this part should be treated with reference to the liability of this structure to liquid infiltrations.

The Clitoris, formed chiefly of an erectile structure like the corpus cavernosum of the male, arises by two branches from the ramus of the ischium and pubis, and has a small prepuce formed by the extension of the membrane covering the nymphæ. Occasionally the clitoris gives rise to such irritation as may demand its removal.

Below the clitoris, and within the nymphæ, there is found a triangular smooth surface, about three-fourths of an inch long, called the Vestibule. This surface terminates inferiorly, or posteriorly, in the orifice of the urethra, and is one of the points in which lithotomy is performed.

The female Urethra is from twelve to fifteen lines long, and pursues a direction which passes in a line from below upward and from before backward. Its vesical extremity is the largest, and its vulvular orifice the smallest, representing in this arrangement a cone, the base of which is toward the bladder; hence, small calculi escape readily, and simple dilatation of the orifice facilitates the passage of those of a large size. At the orifice may be found a marked rising, or tubercle, which is an approach to the bulb of the urethra as seen in man, and serves as a guide to the finger of the surgeon when introducing the female catheter. Near its commencement, the urethra is close to the vagina, but as it ascends it becomes separated from it by a triangular space corresponding with the vestibule, which is occupied by a very loose cellular tissue.

Below the urethra is the orifice of the Vagina, which, in virgins, is often closed by the membranous expansion known as the Hymen. Most frequently this membrane is thin, delicate, and readily lacerated, though sometimes, when dense and imperforate, or thickened by inflammation, it demands the use of the bistoury, in order to permit the escape of the menstrual fluid, or sexual intercourse.

The vesico-vaginal septum is sufficiently extended, reaching even as far as the boundaries of the anterior face of the vagina, and creating rather a vesico-uterine than a vesico-vaginal septum.

Between the vagina and the rectum, for a distance of fifteen lines above the anus, is a condensed areolar and adipose tissue, uniting the two canals, and constituting the recto-vaginal septum, and above this the peritoneum descends so as to form the recto-vaginal pouch. Below the recto-vaginal septum, or in the perineum proper of some anatomists, there is found the skin, anterior extremity of the sphincter ani muscle, the perineal fascia, and the posterior portion of the sphincter vaginæ muscle, together with a connective tissue which is remarkable for its laxity and the number of blood-vessels which run to it.

The muscles of the female perineum are very much the same as those found in the male, but they are usually less developed, with the occasional exception of the sphincter vaginæ. The levator ani is also separated in front by an interval which is occupied by the vagina and neck of the bladder.

The blood-vessels and nerves do not differ materially from the arrangement found in man, being chiefly branches of the pudic artery and sciatic or sacral nerves.

In studying the layers of the vulva from before backward, there may be noted: 1, the mucous membrane; 2, a vascular and connective tissue containing the roots of the clitoris, covered by the erector clitoridis muscle, and having the anterior extremities of the sphincter vaginæ muscle upon its sides; 3, the triangular ligament traversed by the urethra, and containing the transversalis perinei artery; 4, the dorsal veins of the clitoris and the plexus which surrounds the neck of the bladder; lastly, the inferior and anterior portion of the bladder, through which the incisions are made in lithotomy, as practiced in the female.

SECTION II.

DISORDERS OF THE EXTERNAL ORGANS.

The **External Organs of the Female** being covered by skin and mucous membrane, and presenting a large number of sebaceous and mucous follicles, are liable to inflammation from various causes, which shows itself as eczema, abrasion, ulceration, and tumors, from obstruction of the ducts of the follicles.

§ 1.—Eczema of the Vulva.

When eczema or herpes is developed in the **Vulva**, the itching is often intolerable, while the serous discharge and excoriation are exceedingly annoying. The general principles applicable to the treatment of eczema, wherever developed, are all that is necessary for the relief of the affection in this organ; such as the application of heat and moisture by means of the constant use of cloths saturated with warm mucilage, and covered with oiled silk, until the heat and redness is diminished, after which cloths wet with a weak solution of the acetate of lead should be applied. Should the external irritation be due to a vaginal discharge, the latter should be promptly treated, the patient's digestion being carefully attended to. Anodyne and alkaline washes, as a solution of borax and morphia, are very useful.

PLATE LVIII.

INSTRUMENTS EMPLOYED IN OPERATIONS UPON THE VAGINA AND RECTUM.

Fig. 1. Lever Speculum of Marion Sims, for elevating the posterior face of the vagina. 1. Surface which is applied to the posterior face of the vagina. *Kolbè's pattern.*

Fig. 2. Sims's Smaller Speculum for elevating the anterior end of the vagina. *Kolbè's pattern.*

Fig. 3. Sims's Knife, for freshening the edges of a vesico-vaginal fistula. *Kolbè's pattern.*

Fig. 4. Sims's Needle, for inserting the sutures in a vesico-vaginal fistula. *Kolbè's pattern.*

Fig. 5. Sims's Crotchet, for sustaining the traction made in drawing upon the threads. *Kolbè's pattern.*

Fig. 6. Sims's Hook, for seizing the edge of the fistula, or the loop of a suture. *Kolbè's pattern.*

Fig. 7. Small Blunt Hook, to support the edge of the fistula when being transfixed by the needle. *Kolbè's pattern.*

Fig. 8. A Fork to sustain the traction made in tightening the wire ligatures. *Kolbè's pattern.*

Fig. 9. Forceps for seizing the wires and fastening the shot in closing the sutures. *Kolbè's pattern.*

Fig. 10. Sims's Female Self-Retaining Silver Catheter, as employed in vesico-vaginal fistulæ. *Kolbè's pattern.*

Fig. 11. Ordinary Female Catheter of Silver. " "

Fig. 12. Meigs's Shield for the vulva in incurable vesico-vaginal fistulæ. *Kolbè's pattern.*

Fig. 13. Bivalve Speculum Vaginæ. " "

Fig. 14. Univalve Speculum. 1. Handle. 2. Vaginal portion. *Kolbè's pattern.*

Fig. 15. Fenestrated Speculum, open on the side, and applicable either to the vagina or rectum. 1. The fenestrum. *Kolbè's pattern.*

Fig. 16. Ordinary Rectum Speculum for dilating the anus. " "

Fig. 17. Disk Pessary for prolapsus uteri. " "

Fig. 18. Physick's or Meigs's Ball Pessary—silver gilt. " "

Fig. 19. Hodge's Curved Pessary. " " " "

Fig. 20. Chase's Vaginal Syringe. 1. Shield to close the vulva and assist in retaining the injection. *Kolbè's pattern.*

Fig. 21. Double Canula for ligating uterine polypi. " "

Fig. 22. A Rectum Bougie. " "

Fig. 23. A "Porte Meche" for inserting lint in fistula in ano. " "

Fig. 24. Gibson's Stylet for puncturing the rectum in incomplete fistula. *Kolbè's pattern.*

Fig. 25. Spring to carry the ligature after the puncture is made. *Kolbè's pattern.*

Plate 58.

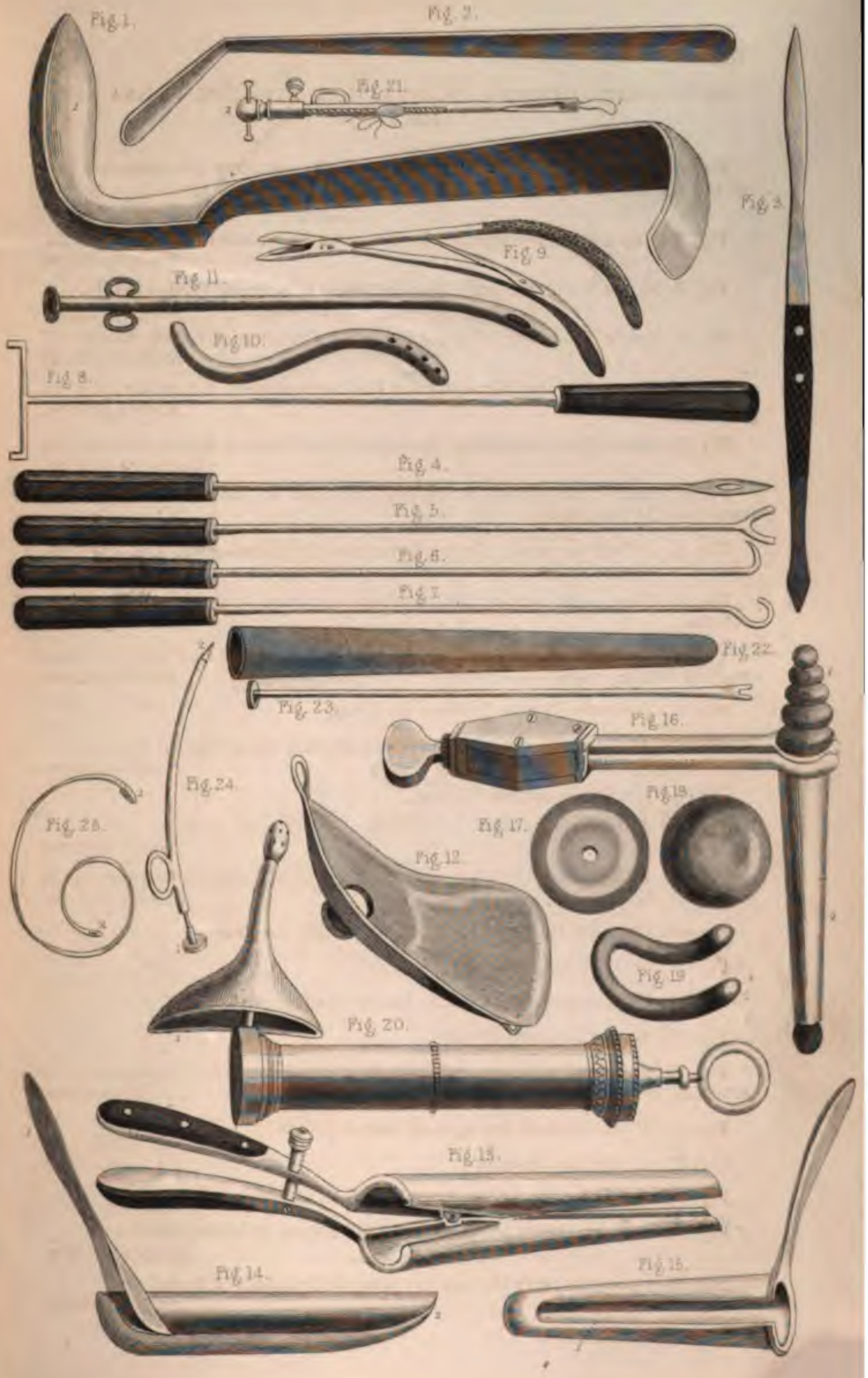
Fig. 1.
Fig. 2.
Fig. 21.
Fig. 3.
Fig. 9.
Fig. 11.
Fig. 10.
Fig. 8.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 22.
Fig. 23.
Fig. 16.
Fig. 24.
Fig. 18.
Fig. 25.
Fig. 17.
Fig. 12.
Fig. 19.
Fig. 20.
Fig. 13.
Fig. 14.
Fig. 15.

§ 2.—Occlusion of the Vulva.

Various evils result from the continuance of inflammation in the external organs of the female; thus in the young child adhesion of the adjacent surfaces may close the **fissure of the vulva**, interrupt the escape of the urine, or ultimately create an obstacle to sexual union. It is, therefore, important to prevent or relieve it promptly, by dusting the excoriated parts freely with finely powdered starch, or by keeping a slip of cloth, wet with mucilage, constantly between the labia. In infants, when the labia are partially adherent, it is only necessary to slip a stiff probe beneath the new adhesions and lacerate them; or, if they are of a firmer character, to incise them carefully in the median line by means of a director and bistoury. Ointments are objectionable applications in these disorders, as they are liable to be decomposed by the heat of the parts, and become a source of irritation.

§ 3.—Inflammation of the Hymen and Enlarged Follicles.

Occasionally the surgeon will be consulted in reference to a vulva irritation, accompanied by the presence of small pink grain-like bodies that are found in connection with the **Hymen.** In two cases that I have seen, these bodies appeared to be formed of the obstructed mucous follicles of the hymen and orifice of the vagina, and to require the free use of dry astringent powders, as tannic acid, or equal parts of sulphate of zinc and powdered gum-arabic dusted over the inferior edge of the hymen with a camel's-hair pencil.

Similar growths, or **Warts of the Epithelial Tissue,** are also met with in the adult female, being due to continuous irritation. These warts vary in size from a mustard seed to that of a mulberry, and are simply a hypertrophy of the follicles, and are not always venereal, yielding, like warts on the penis, to excision with the scissors and the application of astringents, or to the use of chromic acid, as before directed.* When deprived of the epithelial covering, these bodies often become exceedingly sensitive, and a source of great inconvenience. Bathing in lead-water, leading to a deposit of the carbonate of lead on the surface, diminishes their sensibility, after which chromic acid may be applied to a few spots at a time.

The **sensitive tumors,** near the female urethra, described by some writers, I have never recognized. Inflamed carunculæ myrtiformes I have occasionally met with, and, when the anterior horns of the hymen run well up, they may remain and form these sensitive bodies, the origin of which it is not easy otherwise to explain. Excision and cauterization is said to be the best treatment. Ulcers of these parts, of a non-syphilitic or carcinomatous character, are rare, and amenable to general laws. **Condylomata** of this region present nothing peculiar, and have been before described. Abscesses of the labia should be promptly evacuated, and cystic tumors treated, as elsewhere directed, by extirpation.

§ 4.—Hypertrophy of the Clitoris.

Enlargement of the Clitoris of a marked character may be a simple hypertrophy, or the result of a malignant growth, analogous to cancer or Epithelioma of the Penis. If the latter, much benefit will be derived from the use of the dried sulphate of zinc. When the simple hypertrophied condition causes serious evil, its amputation may be accomplished by making an elliptical incision around the base of the clitoris, holding the portion to be amputated in a ligature or pair of forceps, and carefully ligating the arteries of the clitoris as the incisions progress, the retractions of the vessels often creating profuse hemorrhage, and in some instances requiring the application of the persulphate of iron or the actual cautery. Hemorrhage, in amputation of even a moderately enlarged clitoris, will demand attention.

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* Vol. i. p. 316.

§ 5.—Polypi of the Urethra.

Polypi of the Female Urethra are generally pedunculated, and may be removed by the ligature, like polypi elsewhere.

§ 6.—Catheterism.

In the introduction of the **Female Catheter,** the course and length of the urethra should be remembered, especially if a tumor or displaced womb exists at the same time.

Operation.—Place the patient either upon the side or back with the knees drawn up, and then, without uncovering her, pass the forefinger of the left hand, slightly flexed, to the posterior commissure of the vulva, separate the labia with the knuckle, pass the pulp of the finger to the anterior or superior margin of the orifice of the vagina, feel for the urethral tubercle, and, passing the catheter along this finger as a director, carry it gently upward and backward so as to present its concavity under the arch of the pubis. As soon as the point enters the bladder, close the end of the instrument with the finger, and apply a small bowl to receive the urine. In withdrawing the catheter, the end should also be closed with the finger, to prevent the urine soiling the bed, the motion by which the instrument was introduced being reversed.

§ 7.—Imperforate Hymen.

When the **Hymen** is thickened by inflammation, or is imperforate, and causes inconvenience by retention of the menses, puncture it with a bistoury or thumb-lancet, and make a crucial incision, to prevent union of the wound from the collapse of the membrane. Extreme sensibility of the Hymen is sometimes the result of inflammation developed either by its partial rupture or by extension of inflammation from the adjacent surface. Cold anodyne and astringent applications generally relieve it. But a puncture, under these circumstances, will sometimes create quite a free bleeding, which is only arrested by the shriveling of the membrane.

§ 8.—Occlusion of the Vagina.

Occlusion or Imperforation of the Vagina may result either from congenital defect or from inflammation developed by injuries, or from extended vaginitis, though most frequently the cause is a mechanical injury, or it is the effect of a protracted labor. When obliterated, the aid of the surgeon must be sought in order to restore the function of the canal, and give exit to the menstrual fluid or permit sexual intercourse. As such cases necessarily vary much, it is impossible to lay down any precise plan of proceeding, and the operator should, therefore, be mainly guided by his anatomical knowledge of the part, and by the contractions that are well known to follow the formation of cicatricial tissue.

When imperforation of the vagina is perfect and congenital, an accurate diagnosis of the existence of a womb should first prove the necessity for the operation, as, until this can be settled, no treatment ought to be attempted. But should the evidence of the presence of this organ be satisfactory, the dissection may be prosecuted by placing the woman in the position for lithotomy, introducing a catheter into the bladder, a finger or bougie into the rectum, and then cautiously incising the intermediate portions of the line of the natural curve of the vagina, until the uterus is reached, or until the depth of the incisions excites a fear of penetrating the peritoneum at the point of its reflection from the bladder. Subsequently, the parts should be prevented from adhering by the use of emollient dressings and bougies. An instructive case of this operation has been reported by Meigs, of Philadelphia.*

Operation of Randolph, of Philadelphia.—The operator being seated in front of the patient, and the latter placed upon her back, with the knees drawn up, a strong metallic staff, slightly curved, was introduced into the bladder, and held by the assistant. Then, while the left index finger was kept in the rectum, the tissue between the urethra and rectum was dissected very nearly up to the substance of the womb itself by horizontal strokes of the bistoury. Not being able to find the os uteri, the operation was now suspended, a silver-gilt bougie, four inches long, and as thick as the thumb, directed to be constantly employed to preserve the newly-formed canal, and the patient sent home. Three months subsequently, after constantly wearing the bougie, the lady returned to the city, suffering from uterine distention, when the vagina was found to be covered with a smooth surface resembling a mucous membrane, and a tumor could be distinctly felt through the upper end of the canal. On puncturing this with a trocar and canula, a viscid substance was evacuated, the patient relieved, and the menstrual fluid subsequently found to escape by the vagina. The latter, however, contracted until nothing was left but a sinuous opening sufficient for the menstrual fluid.

In operating for the relief of occlusion of the vagina, special attention should be given to the previous history of the case, and if the defect has been the result of inflammation developed by injuries to the part creating an atresia or contraction of the canal rather than its perfect obliteration, the tendency of inodular structure to contract should be stated to the patient before commencing any treatment. Great disappointment has ensued in two cases, that I have seen in consultation, from the return of the constriction, after the vagina had been incised and dilated to its full extent, and this contraction supervened in one case notwithstanding the efforts of a vigorous husband to prevent it. Mott, of New York,† and Ewart, of Charleston,‡ have also reported cases in which the contraction returned, notwithstanding every means was employed to prevent it. When the diseased tissue is extensive and near the vulva, it is better to attempt the introduction of a slip of skin from the vulva, by a plastic operation, or obtain the alterative effects of the frequent and light applications of the nitrate of silver, than resort to the dissecting or incising operation just described. Though the latter may succeed sometimes, it will not invariably do so.

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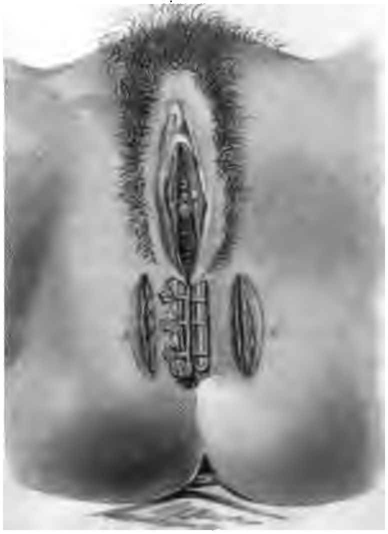
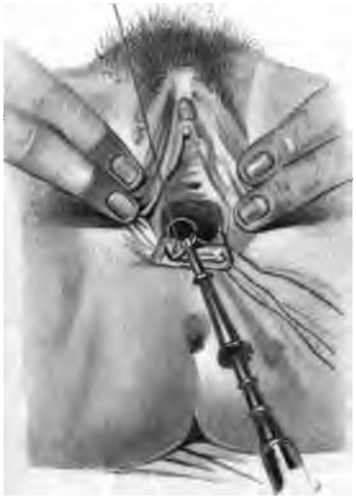
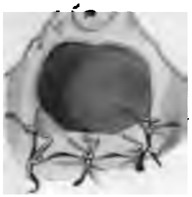
* Pract. of Med., 2d edit. p. 383.

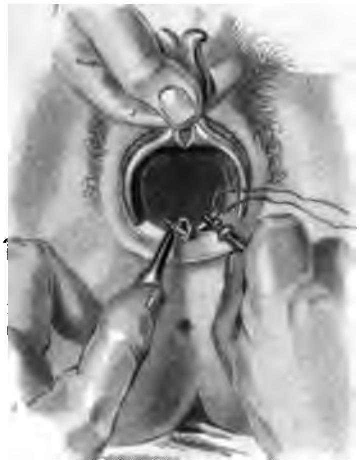
† N. Y. Med. Times, vol. ii. p. 1, 1852.

‡ Charleston Med. and Surg. Journal, vol. viii. p. 81, 1853.









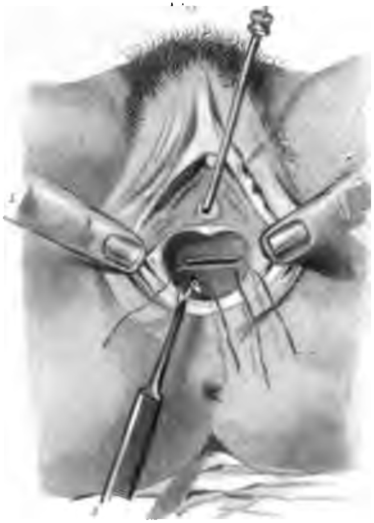


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PLATE LIX.

OPERATIONS UPON THE FEMALE GENITO-URINARY ORGANS.

Fig. 1. Operation of Celsus for closing a recent laceration of the Perineum, as modified by Dieffenbach. After uniting the sides of the laceration by the application of the quilled suture, two lateral incisions are made so as to relieve the tension of the perineum. 1. Quilled suture. 2, 2. Lateral incisions of Dieffenbach. *After Bourgery and Jacob.*

Fig. 2. Roux's Operation for the cure of a Recto-Vaginal Fistula, which was situated behind the recto-vaginal septum. A quadrangular flap has been detached from the posterior parietes of the vagina, drawn forward, and then attached to the freshened edges of the integuments, near the fourchette. 1, 1. Fingers of assistants. 2. The needle-holder. *After Bourgery and Jacob.*

Fig. 3. Enlarged drawing of the same, showing the position of the sutures and the line of union. Two stitches of the interrupted suture are placed on each side as well as front. *After Bourgery and Jacob.*

Fig. 4. Suture of a Longitudinal Recto-Vaginal Fistula. 1. The hand of an assistant dilating the vagina with a bivalve speculum, so as to fully expose the fistula. 2. The hand of the surgeon in the act of forming the suture after the edges of the fistula have been freshened either by caustic or the knife. *After Bourgery and Jacob.*

Fig. 5. Deyber's Operation for the cure of a Transverse Vesico-Vaginal Fistula. 1, 1. Fingers of the assistants exposing the parts. 2. The stylet, which, being introduced through the urethra, is about to pass the thread through the posterior lip of the fistula. 3. The forceps seizing it. The suture at the opposite angle is seen as applied, but it is not tied until all the threads are placed. *After Bourgery and Jacob.*

Plate [illegible]

Fig 1

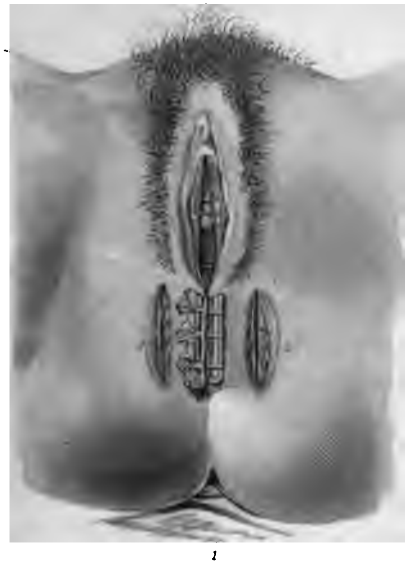


Fig 2

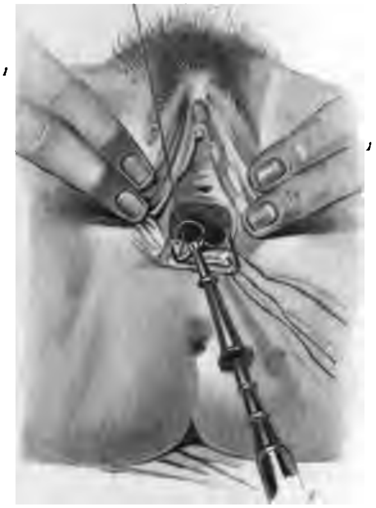


Fig 3

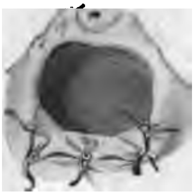


Fig 4

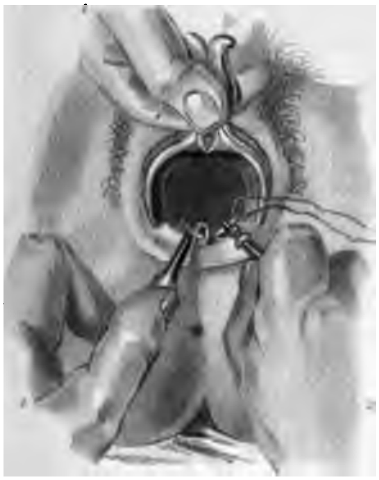
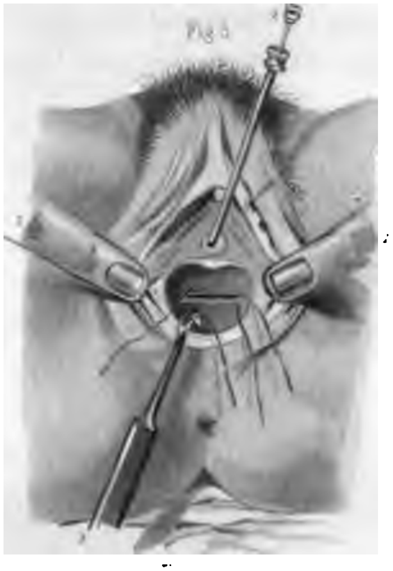


Fig 5



SECTION III.

LACERATION OF THE PERINEUM.

Laceration of the Perineum may result from mechanical injury, as falls upon legs of stools, etc., or, as in one case under my care, from the blow of the horn of a pet deer. But the most common cause is parturition, the tear being the result either of inattention or inability on the part of the accoucheur to support the perineum, especially in a first labor, or in consequence of the improper application of the forceps. When caused by parturition, this condition may present three varieties: 1st. Simple laceration of the skin from the fourchette more or less toward the anus. 2d. Division of the areolar tissue, superficial perineal fascia, and fibres of the constrictor vaginæ muscle. 3d. Laceration of the recto-vaginal septum, with some division of the constrictor vaginæ muscle as well as of the sphincter ani muscle—the laceration of this muscle being the most serious form. In the first and second varieties, the prompt apposition of the edges, by simply keeping the limbs closed for a few days, will often suffice for a cure. But if not noticed until the edges of the laceration have cicatrized without union, the patient will be disposed to prolapse of the vagina and uterus, and to an enlargement of the vaginal orifice that impairs sexual intercourse and causes other serious inconvenience. In the third variety, the evils are more marked, consisting in an inability to control the rectum, in consequence of which gas and feces constantly escape; in the persistence of a serous diarrhœa; in procidentia uteri; and in an excoriation of the adjacent surfaces, which render the unfortunate female disgusting to herself or a burden to her friends.

Diagnosis.—Laceration of the perineum, if looked for, is easily recognized; but unfortunately it is not noticed until too late to hope for union by the simple process of nature, except in the first and simplest variety. When a patient, within a day or more of labor, complains that "*she suffers from the piles*," a careful examination of the anus and perineum should be made, the orifice of the vagina being temporarily plugged with a sponge to arrest the lochiæ.

Prognosis.—The prognosis will vary with the extent of the injury. Simple closing of the limbs, and keeping them so for three days, will often cure the first variety, while an operation by suture or suture and freshening of the edges with divison of the sphincter ani muscle will be required for the second and third varieties. In the latter, though the cure is frequent, the result is somewhat uncertain. The evils of an unhealed laceration have been before stated.

Treatment.—The treatment of the second variety consists in thoroughly cleansing the edges of the rent, if seen promptly, or in freshening them if seen later, and approximating them by the silver and quilled suture, the bowels being kept at perfect rest for five or six days. The third variety being the most common and serious, constitutes the usual class of cases requiring the operation for lacerated perineum. This may be performed in various methods, as hereafter stated, each being applied to special cases. In all cases, however, the general rules laid down by Dieffenbach, of Berlin, should be observed:—

1. To thoroughly prepare the patient for the operation by emptying the bowels, shaving the parts, etc.

2. To operate as soon as possible after the occurrence of the injury, even when the parts are tumid from the labor. Baker Brown, of London, has,

however, advocated* with great reason a departure from this rule, when the patient is not seen on the first or second day after delivery, deeming it best in all other cases *not* to operate until after the third month, as the parts will then better bear the denuding of the edges, and be sufficiently strong to sustain the suture.

3. To employ three or five twisted or quilled sutures, commencing at the anus and ending at the fourchette, closing first the torn angle of the sphincter ani.

4. To administer enough opium to keep the patient quiet and the bowels at rest, the urine being regularly drawn off by the catheter.

Dieffenbach's Operation.—The parts being prepared, and the patient placed in the position for lithotomy, in a good light, raise the edges of the fissure by forceps, and freshen them by excising the indurated portion with curved scissors or a bistoury. The side of the rectum being now united by a fine single point of the interrupted suture, deeply introduced, close the middle of the fissure, and, applying four stitches of the quilled suture, at equal distances, approximate the parts accurately; as the loss of substance puts the united parts upon the stretch, make two lateral incisions, half an inch on each side of the posterior margin of the external labiæ, Plate LIX. Fig. 1, which will soon relieve the tension of the line of the fissure, and, by filling up with granulations, prevent future traction on the cicatrix until it becomes firm. The sutures being allowed to remain till loosened, care is to be taken to keep the bowels in a soluble condition by employing daily injections after the seventh day.

Mettauer, of Virginia,† in the case of a lady, thirty years of age, who suffered a laceration of the perineum during parturition six months previously, from which there resulted "a complete disunion of the recto-vaginal wall from the verge of the anus three inches up the rectum, terminating superiorly in an obtuse angle, the rectum being contracted upon itself so as to render its several teguments a mere band of the width of five-eighths of an inch, while the retaining power of the sphincter ani was destroyed," operated as follows:—

Operation.—The patient being placed in the position for lithotomy, with the knees held wide apart, denudation of the margin of the fissure to the extent of three-fourths of an inch was accomplished by the aid of hooks, scissors, and scalpels, according to circumstances. The bleeding being arrested, leaden ligatures were introduced in succession from within out, and from the angle to the verge of the fissure, at the distance of one-fourth of an inch apart, by means of curved needles threaded with silk, to the loop of which a leaden wire was attached Physick's needle proved very useful in introducing these threads, and, as the leaden ligatures were successively tightened by twisting them sufficiently to bring the abraded surfaces in contact, their ends were cut off. Twelve ligatures were required to close the breach, and these being subsequently tightened, the margins of the wound were cauterized with the nitrate of silver. The patient was then kept perfectly quiet in bed, with the knees tied together; the bowels were not moved for four days, and then the matter did not escape through the fissure. The ligatures were removed in six weeks, and the union was perfect. In this case the metallic suture was employed, many years before Sims suggested its more general application.

Plastic Operation of Horner, of Philadelphia.‡—In this patient the laceration was complete from the vulva to the anus, the parts were cicatrized over an inch deep, and but one fissure was apparent from near the os coccygis to the clitoris; there was a constant tendency to diarrhœa, and much of the fecal matter passed through the rima vulvæ.

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* On Surgical Diseases of Women, Philada. edit., p. 38.

† Am. Journ. of Med. Sciences, vol. xiii. p. 113, 1833.

‡ Ibid., vol. xx. p. 329, 1850.

Operation.—A previous operation by freshening the edges and the use of sutures having failed, the patient submitted to the following operation fifteen months after the first:—

After being thoroughly etherized, two flaps were made from the perineum adjacent to the vulva, one on the right and the other on the left side, twisted on their bases, crossed between the rectum and vulva, and fastened by sutures, so that the right flap formed the upper part of the rectum, and the free side of the left the lower part of the vagina; stitches of the interrupted suture along the rectum and along the vagina closing each of these cavities by the approximation of their raw surfaces. For ten days there was no fecal discharge, but at this time the union, though not perfect, kept the septum in position, and ultimately benefited, though it did not cure, the deficiency. I have recently seen this lady—the recto-vaginal septum is tolerably good, but the action of the sphincter ani is imperfect. As in her present state she can render herself comfortable, and retain feces and flatus, except in occasional attacks of diarrhœa, and as she suffered seriously in previous operations from erysipelas, etc., I advised her to remain content with her condition, and run no further risk of her life.

Baker Brown, of London, who has been remarkably successful in the results of his operations, in the worst form of laceration, lays much stress* on the division of the sphincter ani muscle, and operates as follows: After previously preparing the patient, by cathartics, etc., he selects a scalpel, probe-pointed straight bistoury, long dissecting forceps, three large needles for the deep quilled suture, and small ones for the superficial interrupted suture, two pieces of quill, or bougie tenaculum. Instead of the silk ligature, the metallic thread, as originally used in 1833 by Mettauer, of Virginia, and before described, will be better.

Brown's Method.—After etherization, place the patient in the position for lithotomy, shave the parts thoroughly, and let one assistant render tense the sides of the fissure. Then make a clean incision, about one inch external to the side of the fissure, throughout its entire length, and deep enough to reflect inward the mucous membrane, and lay bare the whole surface of the laceration on one side. Then do the same on the other side, connecting the two incisions and paring away any intermediate portion of the mucous membrane, over the recto-vaginal septum. When the fissure is thus thoroughly denuded of every portion of mucous membrane, the left forefinger should be introduced within the margin of the anus. Then pass along it the probe-pointed bistoury, and cutting firmly outward and backward, from within the rectum, divide thoroughly all the fibres of the sphincter ani muscle and the subcutaneous areolar tissue, each side of the coccyx, and about a quarter of an inch in advance of its point, cutting to the extent of an inch or two, external to the anal orifice, thus destroying all muscular traction by freeing the sphincter ani from its origin in the coccyx. The degree of relaxation thus sought for must be regulated by the extent and character of the laceration, it being remembered that the freer the incision in this line the greater will be the relaxation.

The thighs being now somewhat approximated, the sutures should be thus placed: Having a strong needle carrying a double thread—as directed for the quilled suture—seize the denuded tissues on the left side, between the left forefinger and thumb, and plunge the needle, with the right hand, through the skin and subjacent tissues, introducing it one inch external to the pared edge, and carrying its point deep downward and inward, until it reappears on the inner edge of this side of the denuded surface. Introducing it at the corresponding margin of the opposite denuded side, make it traverse the tissues on the right side, in a direction upward and outward, until it escapes at a point one inch distant from the external margin of this side. The first suture being placed near to the rectum, introduce, in a similar manner, two others at equal distances, one above the other, and inclosing the quills secure the ligature firmly on them, so as accurately to approximate the deep denuded tissues. Then, passing the right forefinger into the vagina and the left into the rectum, ascertain that these deep parts are completely joined, and, withdrawing the fingers, close the skin only on the line of the raphe by three or four points of the interrupted metallic suture, and, cleansing the parts carefully by a sponge, apply the water-dressing, retaining it in position by a T-bandage.

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* Brown, op. cit.

After-Treatment.—Place the patient on her left side in bed, with the limbs closed, and flexed on the abdomen; give two grains of opium at once, and one grain every four or six hours subsequently. Ice to be sucked, arrow-root or beef tea for the first twenty hours, and, if no fever supervene, give a generous diet after the second day.

It is important that the catheter should be regularly employed thus: Pass it from behind the buttocks between the thighs, and keep the end closed by the thumb, as it prevents the urine dropping on the wound. On the eighth or ninth day, if all goes well, the patient may, on her hands and knees, be allowed to pass her water. The deep quilled sutures may be removed on the fifth or sixth day, and the external interrupted sutures a day or two later, taking care, in the removal of each, not to separate the thighs. The opium should be persevered in for two or three weeks, so as preserve constipation, the bowels being opened for the first time only when the adhesion seems firm, a dose of oil being given at night, a tepid injection in the morning, and the perineum supported when the first hardened feces escape.

When, from any cause, adhesion is not complete throughout, the application of the nitrate of silver or the actual cautery may be necessary.*

In the cases in which I have practiced this operation of Brown's, I have employed coarse metallic threads for the deep, and finer for the superficial sutures, introducing a Sims' catheter, and leaving it in the bladder—points which will be found useful as modifications of the original operation, as there is no necessity to remove the metallic threads before the tenth day, or even later, as the irritation they create is trifling. The division of the sphincter ani muscle, as proposed and practiced by Brown, is of great consequence to a successful result.

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* Brown, op. cit.

CHAPTER VII.

OPERATIONS FOR VAGINAL FISTULÆ.

From the relative position of the female bladder, urethra, and rectum to the vagina, it occasionally happens that sloughing or ulceration of the intermediate tissues produces a direct communication between these parts, through which either urine or feces escape into the vagina. Such openings are usually designated as **vaginal fistulæ**, and may be either **vesico-vaginal, utero-vaginal**, or **recto-vaginal**, according to the viscus into which they open.

SECTION I.

VESICO-VAGINAL FISTULA.

Pathology.—In **Vesico-vaginal Fistula** there exists an opening of greater or less extent between some portion of the vagina and the urethra or bladder, or both, which varies greatly in character and depth under different circumstances. Most frequently this opening is the result of sloughing, consequent either upon the long-continued pressure of these parts against the pubis by the child's head in parturition, or of the inflammation or laceration induced by the improper use of instruments, or from the presence of foreign bodies in the bladder or vagina.

When any of these causes impairs the vitality of the part, the portion affected is liable to separate or slough out, and leave an ulcerated opening with irregular edges, which, by the deposit of lymph in the efforts of nature to repair the loss, become thickened and indurated. From the loose character of the attachment of the mucous coat of the bladder, and the efforts at straining, a fold or two of the latter is also often forced into the vagina at the edges of the ulcer. Tedious labor and neglect of the condition of the bladder being the most common cause, the fistula will be found at some point either of the bas-fond or neck of the bladder, or at the posterior two-thirds of the urethra. When the result of labor, the opening is most commonly transverse, the size of it being diminished by the os uteri being drawn downward and forward, so as to relax the anterior wall of the vagina. But when the fistula has been excited by the action of instruments, it is more frequently longitudinal.

The evils resulting from the existence of a vesico-vaginal fistula, as well as the difficulties of the cure, will depend in a great measure on the diameter and position of the opening; these evils and difficulties being greater in proportion to the proximity of the fistula to the bas-fond of the bladder, and least when it is in or near the anterior portion of the urethra.

The treatment of a vesico-vaginal fistula may be either palliative or curative, but the latter was so rare in a perfect degree that Velpeau and others formerly asserted that, "among all the cases related of cures, there were but a very small number that were entirely free from doubt."* Subsequently he modified his statement by making it especially applicable to those in which the bas-fond of the bladder was involved. The experience of Hayward, Mettauer, Sims, Bozeman, and others, especially in the United States, has, however, frequently proved that these fistulæ are perfectly amenable to treatment. The complaint may, therefore, be treated either by the palliative or the radical plan of proceeding.

§ 1.—Palliative Treatment.

Without spending time in referring to the treatment of these fistulæ by means of sponges and plugs introduced into the vagina, they being at best but imperfect means of preserving cleanliness and preventing excoriation, I shall at once call attention to a simple contrivance and bandage suggested, I think, by Meigs, of Philadelphia. This instrument—which explains itself, Plate LVIII. Fig. 12—resembles somewhat an oyster-shell, fits accurately to the vulva, and is held in its place by the attachment of a T-bandage, while a caoutchouc bottle, which is fastened on an opening at the lower end of the shield, is then attached around the thigh, and receives the urinary secretion. In old and incurable cases, such a shield, made of silver and gilt, with the urinal attached, will be found of great service, and add much to the comfort of the patient.

When the fistula is comparatively recent, even though very large, the patient may be much benefited by the frequent application of the nitrate of silver to the edges of the ulcer, so as to favor the formation of granulation, while in recent cases, and in those limited to the urethra, the use of the catheter, and of highly astringent injections into the vagina, with perseverance in such a position—lying on the stomach—as will favor the escape of the urine through the upper half of the urethra, combined with the use of nitrate of silver, will often diminish very materially the fistulous orifice.

§ 2.—Operations for Vesico-Vaginal Fistulae.

The difficulties attending the closure of a vesico-vaginal fistula by freshening its edges, and approximating them by various kinds of sutures, have led surgeons to suggest the use of different instruments, and to recommend various modes of operating. To recapitulate all these would be as tiresome as it would be useless, and this account will therefore be limited to a few which have been selected from among the cases reported by such surgeons in the United States as have paid special attention to the subject.

Operation of Hayward, of Boston.†—At the close of a series of cases reported by this surgeon, the following account of the operation is given:—

Operation.—The patient being placed as for lithotomy, and thoroughly etherized, but not tied, a large-sized bougie made of whalebone and highly polished should be introduced through the urethra to the very fundus of the bladder, so as to depress it toward the vagina by elevating the end of the bougie toward the pubis. After bringing the edges of the fistula fully into view, the callous portion should then be excised either with the curved scissors or knife, or both, the edges being held by means of a double hook, while the vaginal covering is dissected from the mucous coat of the bladder to the distance of two or three lines.

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* Velpeau's Op. Surg., by Mott, vol. iii. p. 858.

† Cases of Vesico-vaginal Fistula, by George Hayward, M.D. Boston, 1851.

A short needle, with an eye near the point, and made to fit on a long handle, being then passed through the outer covering of one side of the fistula, should be seized by the forceps and withdrawn from the handle, then drawn through the lips of the wound, fitted again to the handle, and passed through the opposite side in the same manner. As many stitches as are necessary being thus taken, one thread of each should be cut off, and the other left to show when the ligature has separated from the bladder. A large-sized female catheter being now secured in the bladder by a T-bandage, the patient should be laid on her side, with the shoulders raised so as to facilitate the escape of the urine, and the instrument removed every twenty-four hours, in order to prevent its clogging. After three days it may be removed altogether; but the urine should be drawn off every three hours for ten or twelve days more, so as to prevent any strain on the bladder. The diet should consist entirely of liquid, mucilaginous food, until the ligatures separate, and the bowels—which should always be freely evacuated prior to the operation—be kept at rest for some days, as little effort as is possible being also made by the patient to empty the bladder.

Remarks.—Out of nine cases operated on in this manner by Hayward, three succeeded perfectly, five were relieved, and the others not benefited. I have also performed a similar operation on one occasion, with much relief to the patient.

Operation of the Author.*—In a case of vesico-vaginal fistula, in which the opening was about the size of a Spanish quarter-dollar piece, and situated at the neck of the bladder, extending backward toward the orifice of the ureters, and forward to within one inch of the external opening of the urethra, occupying nearly the position of the vesical triangle, I succeeded in effecting a cure by means of the ordinary hare-lip operation—performed January 7th, 1848.

"A piece of soft pine wood, about the size of the forefinger, convex on one side and flattened on the other, was first passed into the urethra, with its flat side next to the vagina, and carried back into the bladder, so as to depress the edge of the fistula. Upon this I cut off the posterior lip of the opening, partly by a vertical-bladed knife made for the occasion, and resembling somewhat an ordinary hoe, and partly by a long-bladed scalpel. By elevating the handle of the stick in the urethra, the anterior lip of the fistula was also readily depressed and its edges pared off, the paring being freely continued into the angles of the fistula. Four long hare-lip pins, slightly bent, and fastened into an acupuncturation needle-holder, were now passed, one after the other, through the anterior lip of the fistula from below upward, and then through the posterior lip from above downward, not transfixing the mucous coat, and the pin, of course, not entering the urethra. Four figure of 8 ligatures thrown around the pins, on the vaginal side, now closed the fistulous opening so perfectly that a fine probe could not be made to pass it, except at a spot between the two central pins." A catheter was introduced as usual. Seven days subsequently, the pins were removed, when it was found that the wound had united, except at the centre, where a gap was left which ultimately closed under the use of the nitrate of silver.

Operation of Mettauer, of Virginia.†—A fistula about the central part of the vesical triangle, of the size of a Spanish dollar, and nearly circular, which had existed six months, and was the result of sloughing, was treated as follows:—

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* Medical Examiner, vol. v. N. S. p. 155, 1849.

† Am. Journ. Med. Sciences, vol. xiv. N. S. p. 107.

PLATE LX.

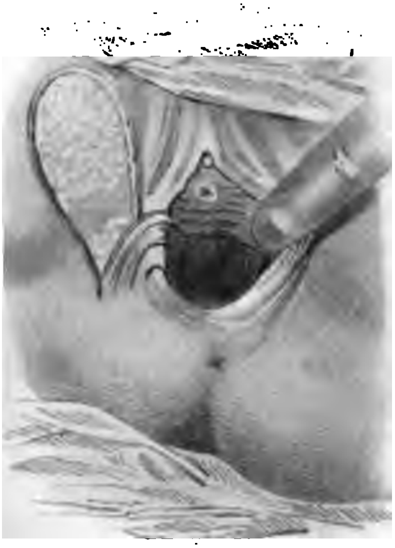
OPERATIONS ON THE FEMALE GENITO-URINARY ORGANS.

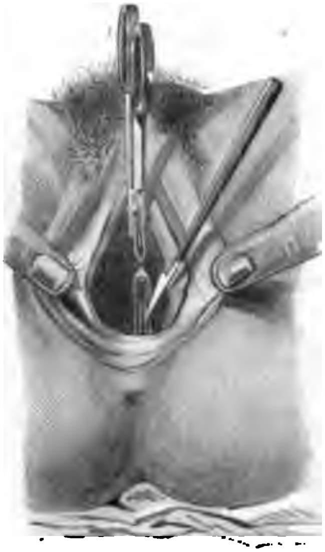
Fig. 1. Jobert's Operation for Elytroplasty, or closure of a vesico-vaginal fistula, by means of a flap taken from the integuments of the labium majus, and twisted upon its base round to the orifice of the fistula, where it is retained by sutures. *After Bourgery and Jacob.*

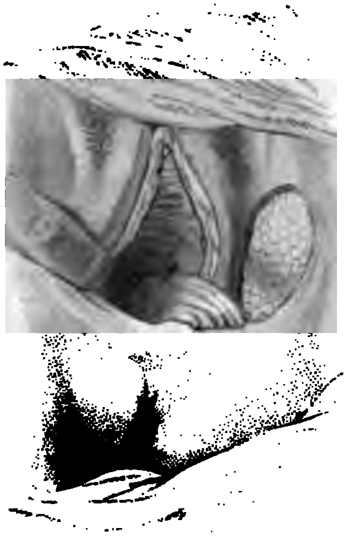
Fig. 2. Freshening the edges of a vesico-vaginal fistula while they are secured in 1, the forceps of Fabri. One blade of the forceps, being furnished with a plate of wood, is passed into the bladder through the urethra, and serves as a point of support for the other blade, which has a fenestrum capable of containing and approximating the lips of the fistula. *After Bourgery and Jacob.*

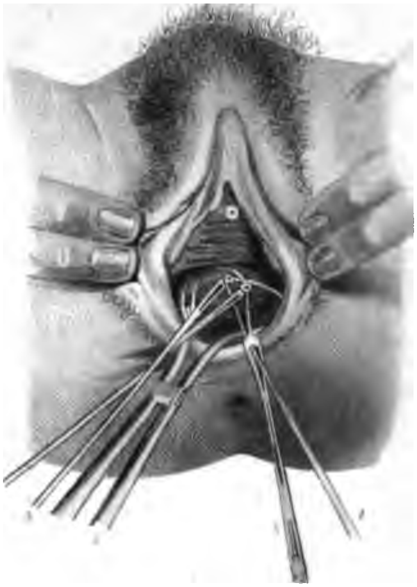
Fig. 3. Velpeau's Operation of Anaplasty for the cure of a recto-vaginal fistula, the flap being taken from the side of the vulva and attached to the freshened edges of the fistula. *After Bourgery and Jacob.*

Fig. 4. Ligation of a large Uterine Polypus. The orifice of the vagina being kept open by the fingers of the assistant, the polypus has been seized with 1, Museux's hooks, and drawn down to the os externum by another assistant. The surgeon having then thrown a ligature around the pedicle of the tumor by means of the two ligature bearers 2, 3, has drawn the ligature 4 through the knot-tier 5, and is about to strangulate it. *After Bourgery and Jacob.*









Operation.—After a preparatory constitutional treatment, the woman was placed and confined as in the operation for lithotomy, and the vagina dilated by two broad spatulæ pressed against its opposite sides, the edges of the fistula being denuded by seizing them with delicate hooks, and trimming them with keen scissors, curved flatwise. A straight needle, thirteen lines long, being then armed with a silk ligature, doubled so as to form a noose fully six inches long at one of its free ends, the bent extremity of a leaden wire of small size was fastened to it, and then by forceps and a porte-needle introduced through the edges of the ulcer, so as to form the first stitch of the leaden suture, the ends of the leaden thread being loosely twisted, so as not to pucker the edges of the fistula. Eight distinct sutures being thus formed and loosely twisted, were progressively tightened until the opening was perfectly closed, when the ends of the leaden wires were brought out at the vulva, and the soft parts protected by investing them with oiled silk, after which a catheter was fastened in the bladder. The wires being tightened on the third, and again on the seventh day, the bowels were not moved until the eighth, and on the thirteenth day the sutures were removed, "perfect union having taken place throughout the entire line of contact." The use of the catheter was, however, persevered in for four weeks for fear of vesical efforts, and the patient subsequently had two children without a return of the accident.

Operation of Sims, of New York City.—**Operation.***—Having prepared the instruments figured in Plate LVIII. Figs. 1 to 10, and given every attention to the general condition of the patient, the operation should be conducted in the following manner:—

Position of the Patient.—In order to obtain a correct view of the vagina, place the patient upon her knees, on a table two and a half by four feet, and have the nates elevated, while the head and shoulders are depressed. The knees should also be separated six or eight inches, the thighs placed at about a right angle with the table, and the clothing so loosely arranged as not to compress the abdomen. An assistant on each side should then lay a hand in the fold between the glutei muscles and the thigh, the ends of the fingers reaching to the labia majora, and by simultaneously pulling the nates upward and outward open the os externum. The pelvic and abdominal viscera being thus made to gravitate toward the epigastrium, the presence of the atmosphere will suffice to distend the vagina to its utmost limits, thus freely exposing the os tincæ and the fistula. To facilitate the view of the operator, the assistant on the right side of the patient should now also elevate the perineum and recto-vaginal septum by means of the lever speculum, Plate LVIII. Fig. 1, a smaller speculum—Plate LVIII. Fig. 2—being used to press the urethra downward against the symphysis pubis when circumstances demand it. In most cases a good northern light on a clear day will suffice for the display of the canal; but if more is requiste, a looking-glass should be so arranged as to throw the rays of the sun upon the part. The orifice of the fistula being now distinctly seen, the next step in the operation is to freshen its edges.

To Freshen the Edges of the Fistulous Opening.—A delicately curved tenaculum—Plate LVIII. Fig. 6—being inserted into the margin of the fistula, a sharp-pointed knife—Plate LVIII. Fig. 3—is made to shave off the edge of the opening to the extent of a quarter or third of an inch, so as to denude the part thoroughly on the vaginal surface, but without removing any of the lining membrane of the bladder, unless it project so much into the vagina as to obstruct the operation, which is rarely the case.

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* Am. Journ. Med. Sciences, vol. xxiii. N. S. p. 59, 1852.

When the fistula is small, there is abundance of tissue, and there need be no fear about removing the parts freely, the success of the operation depending much upon the perfection of the freshened edges. During the scarification, there is always some hemorrhage, which may be readily removed by little probangs of sponge, one assistant attending solely to the preservation of the cleanliness of the orifice.

The Suture.—The object of all the sutures being to unite the freshened edges of the fistula, the interrupted, quilled, and twisted of ordinary wounds have been employed. From its peculiar methods of action, Sims designated his as the "clamp suture." It is composed of fine annealed silver-wire, about the size of a horse-hair, which is fastened to cross-bars after the manner of the quilled suture. The bars may be made of silver or lead, either solid or tubular, highly polished and without any asperities, particularly at their extremities. Acting as clamps, the embraced parts swell up and overlap them, while they produce sufficient ulceration of the vagina to permit their becoming imbedded, and sometimes so hidden from view that they will often remain until surrounded by granulations. This suture may be left untouched for six or ten days, or longer, and has never ulcerated out. If removed too soon, the cicatrix may yield, and judgment must, therefore, direct the proper period for the removal of the clamps.

Placing the Sutures and Closing the Fistula.—With a long needle, Plate LVIII. Fig. 4, armed with silk thread, a puncture is made in the middle of the scarified edge of the fistula, about half an inch anterior to its border, the needle carried deeply into the vesical septum, but without transfixing it, brought out just at the edge of the mucous membrane of the bladder, carried across the opening, entered at the opposite side at a point corresponding with its anterior direction, and brought out on the vaginal surface, about half an inch beyond the scarified edge, but without touching the vesical mucous membrane, when the first thread is placed in position. The passage of the needle through the anterior edge is sufficiently easy; but the loose and yielding nature of the posterior margin renders some support necessary before it can be made to appear on the vaginal surface. To accomplish this, a blunt hook—Plate LVIII. Fig. 7—should be placed flatwise at the point of exit of the needle, so as to make a fixed point for it, when it will readily pass, after which the small tenaculum—Plate LVIII. Fig. 6—may be made to hook up and draw out the ligature from the side of the needle, when the latter may be withdrawn, and the other ligatures passed in like manner. To prevent the cutting and pain which would ensue upon drawing the thread upon the posterior edge of the fistula, a crescent-shaped fork—Plate LVIII. Fig. 5—should be passed in, and made to serve as a pulley for the thread.

The three threads being thus placed, the most difficult part of the operation is finished, and it only remains to substitute the wires and apply the clamps, which is readily accomplished as follows:—

To apply the Wires and Clamps.—Take a piece of the wire, twelve or eighteen inches long, make a small crook at one end, and, fastening it to one end of the silk thread, draw the wire through the edges of the fistula, and bring its ends out of the vagina. Then do the same with the remaining wires, and having made small oblong openings in the bars, either of silver or lead, at distances corresponding with that between the points of the suture, fasten the distal ends of the wire to one bar, either by twisting it round it, or by passing it through a perforated shot, and then bending it over the former. This being done, pull upon the proximal ends of the wires, or that nearest to the orifice of the vagina, and draw the bar up into the vagina above the fistula, or between its upper margin and the os tincæ, using a fork—Plate LVIII. Fig. 8—broad enough to serve as a pulley for all the wires while being drawn into position. Now pass the proximal ends of the wires through the other bar, push it into the vagina till it is placed in front of, and parallel with, the anterior edge of the fistula, and then using the fork to press up the clamp, draw firmly on the wires until the denuded edges of the fistula are so closely in contact that an ordinary probe would not pass between them, when the following simple contrivance will suffice to hold the clamps in position and fasten the wires: Slide a perforated shot over the free end of each wire, push it up to the clamp, and then firmly compressing it on the wire by means of forceps, Plate LVIII. Fig. 9, the shot will be made to serve as a knot to the wire and prevent its being drawn through the clamp. The ends of the wires being then cut off about one-fourth or one-eighth of an inch from the shot, and bent over, they will be effectually prevented from slipping.

The whole operation, which usually occupies twenty or thirty minutes, or, under any circumstances, an hour, being now completed, the patient should be put to bed, and a self-retaining catheter—Plate LVIII. Fig. 10—applied to keep the bladder empty; an anodyne administered, the bowels kept at rest as long as possible, being usually ten or fifteen days after the operation, and the whole followed by a careful after-treatment. The sutures should be examined on the third or fourth day, again on the sixth or seventh, and, if not doing mischief, (exciting too much inflammation or ulceration,) not removed until the ninth or tenth day.

Removal of the Clamps.—Clip off the flattened shot, and elevate the anterior clamp from its bed by a blunt hook, when the posterior clamp may be hooked up with the wires attached, pushed backward into the vagina, disengaged entirely, and then lifted out with forceps. The patient should then remain in bed, and use the catheter for several days to prevent any strain upon the new cicatrix.

Operation of D. Hayes Agnew, of Philadelphia.—The edges of the fistula, which was transverse through the trigone vesicæ, and exceeded an inch in its greatest diameter, "were seized with a pair of rat-toothed forceps, placed upon the stretch, and, with a straight sharp-pointed bistoury, pared in their whole extent. Seven needles, slightly curved at the point, each armed with a silver suture, were carried successively, by means of Gemrig's needle-holder, through the edges of the wound down to, but not beyond, the vesical mucous membrane."

"These sutures being brought out of the vagina, and carefully separated from each other, the two ends of each were passed through a perforated disk of metal, as used and figured by Sims, which being carried down to the wound, and traction made on the wires, approximated the edges very completely. Perforated shot were next run down each suture, and clamped by means of a long pair of strong-bladed forceps."*

Operation of Bozeman by the "Button Suture."—Urethro and vesico-vaginal fistulæ have also been treated by N. Bozeman, of Alabama, who, in an extended paper,† strongly recommends the "button suture," in which the clamp is formed of a disk of lead shaped somewhat like a button, which approximates the freshened surfaces when applied to the metallic threads in very much the same manner that a button closes a vest or coat. Various surgeons, as Gaston, of South Carolina, Wood, of Cincinnati, Baker Brown and Spencer Wells, of Great Britain, have employed it with satisfaction. Bozeman reports twenty-one cases of simple and complicated fistula cured by his method, fifteen being cured by the first operation, a success that is highly satisfactory.

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* Medical and Surgical Reporter, vol. i. N. S. No. 20, p. 339, 1859.

† North American Med.-Chirurg. Review, July and November, 1857.

Remarks.—Although vesico-vaginal fistula cannot be regarded as a common complaint, it is unfortunately too often met with, and every means of affording relief will, therefore, be readily seized by a patient thus dreadfully afflicted. There is, however, a great difference in the utility of the means that have been proposed, and to estimate the value of each of these is by no means easy, when so much must depend upon the position, size, and duration of the fistula, as well as upon the mechanical skill of the operator. The space for manipulation is necessarily small, and yet the neat and accurate apposition of the parts is essential to success; the selection of any one plan of treatment must, therefore, be left to individual judgment and delicacy of manipulation. In three cases, I have obtained relief from different methods of treatment. In a small fistula, in the posterior edge of the urethra, cauterization closed the opening. In a larger orifice, at the anterior end of the vesical triangle, the twisted suture and hare-lip pins induced the union of more than two-thirds of the original fistulous opening. In a third, who had an opening at the neck of the bladder, the interrupted suture, carefully applied, afforded but partial relief. The great point to be observed in all is to support the edges during the adhesive process, prevent traction in the transverse line of the vagina, and keep the bladder empty, and this, it is now believed, can be easily accomplished solely by metallic threads, without the necessity of any "clamps," or "buttons." Experience has also greatly simplified the instruments first suggested, so that the operation may at present be well performed simply by freshening the edges of the fistula—introducing metallic sutures, and closing the wound, either by twisting the metallic threads so as to knot them, or by sliding a perforated shot upon them, and compressing it so as to retain the loop of the suture in its position. In the incurable cases, the vulva shield and bottle—Plate LVIII. Fig. 12—will be found to furnish much comfort, both mentally and physically. In some cases plastic surgery has been brought to bear upon the treatment of this complaint, and the opening successfully closed by sliding a flap from the adjacent parts. Jobert advises the performance of a plastic operation, which he terms "Elytroplasty," while Velpeau recommends "Anaplasty." As these operations are figured in Plate LX. Figs. 1, 3, a detailed account of them is here unnecessary.

SECTION II.

VESICO-UTERINE FISTULA.

In a treatise by Jobert,* on the treatment of vaginal fistula, attention has been especially called to the existence of a rare form of fistula, in which a communication exists between the bladder and uterus above the insertion of the vagina, in consequence of which the urine escapes into the vagina through the os uteri. This complaint is stated by Jobert to arise from the long-continued pressure of the child's head, especially in a deformed pelvis, or from the unskillful use of instruments, or the injury resulting from craniotomy. To relieve this, Jobert advises the *lateral division* of the neck of the uterus, by means of a pair of long blunt-pointed scissors, so as to gain a good view of the fistula, after which he proceeds to treat it by turning up the anterior flap of the neck of the uterus, freshening the edges of the fistula and uniting them; or by applying the flap as a plug, by a plastic operation, the details of which I am compelled to omit, as the rarity of the disease would not justify the space that it would require in a work of the general character of the present treatise.

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* Des Fistules Vesico-Uterines, etc., par A. J. Jobert, (de Lamballe.) Paris, 1852.

Vesico-Utero-Vaginal Fistula is another form of the complaint to which Jobert has alluded, which is also very rare, and which is to be treated on the principles just stated.

SECTION III.

RECTO-VAGINAL FISTULÆ.

Pathology.—In recto-vaginal fistulæ, a communication is established between the rectum and vagina by an opening which is in the anterior wall of the rectum, and the posterior of the vagina. The aperture may be of various sizes, and either congenital or the result of such injury as induces sloughing or the formation of an abscess. Congenital fistulæ of this kind, or an artificial anus opening into the vagina, is comparatively rare, though I have seen one in the case of a child six months old, it being in this case complicated with a deficiency of the lower portion of the rectum, the gut opening into the vagina nearly a half inch above the os externum, and the anus being deficient. The occurrence of cholera infantum preventing any attempt at relief, the child returned to its home in the country, and has not since been heard of. Recto-vaginal fistulæ are frequent, the result of laceration of the vagina and the subsequent inflammation consequent on the improper use of instruments during delivery; they are also generally longitudinal, and give exit to fecal matter and flatus through the vagina as well as the rectum. Position and rest, coupled with a natural tendency in the orifice to close, are often sufficient to effect a cure, and yet it occasionally happens that considerable skill and attention will be required in order to heal them. As the various means referred to in the treatment of the vesico-vaginal fistulæ are equally and more readily applicable to this class, the operative methods need not be so fully detailed as in the preceding variety of fistulæ.

Operation of Barton, of Philadelphia.*—A young lady, after suffering from an abscess, which was discharged, was left laboring under a fistula for four years, which resisted the ordinary treatment by tents, setons, and caustics. This fistula commenced about three-fourths of an inch within the right labium, and passed by a very irregular course up the pelvis, inclining to the rectum, into which it opened at about three and a half to four inches from its inferior aperture in the vagina, giving exit to fluids and flatus through the genitals.

As the sinus could not be included in a seton, and ulcerated through, or laid open without destroying the perineum, it became necessary to adapt an operation to the case.

Operation.—The sinus having been dilated for a few days by a tent, a seton was introduced into the fistula per vaginam, by means of an eyed probe, thence passed through its whole extent, till it entered the rectum by its orifice in that canal, whence it was brought down to, and out at the anus, the two ends being loosely tied merely for security. After a few days the loop was undone, and the end of the seton which came out of the vagina was passed through the eye of a probe previously bent at its other end. This probe being then inserted into the vaginal orifice of the fistula, was carried about an inch and a half up the sinus, and its point directed toward the perineum, just exterior to the sphincter ani muscle, where a small but deep incision was made, the probe pushed through, and the end of the seton brought out and tied to the rectal end of the ligature, thus including in the loop the parts between the outer surface of the sphincter ani muscle and the rectum, the seton being subsequently twisted and drawn tighter and tighter, until it cut its way out, as in the ordinary operation for fistula in ano with the ligature. So soon as the new channel thus formed had attained a larger size than that entering the vagina, the discharges deserted the latter, and it healed up. It then only remained to treat the seton in the same manner as in fistula in ano, till it ulcerated out, when the parts healed, and the lady recovered perfectly. Four years subsequently she was free from the complaint.

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* Am. Journ. Med. Sciences, vol. i. N. S. p. 305, 1840.

R. D. Mussey, of Cincinnati, has also reported a case of recto-vaginal fistula, in which he accomplished a cure by using the "clamp suture" of Sims, as referred to in the section on vesico-vaginal fistulæ.

Roux's Operation for Entero-vaginal Fistula.—"In a case where the ilium terminated in the vagina, Roux opened the abnormal parietes, separated from the vagina the portion of the intestine that terminated in it, and tried to invaginate it into the inferior end by means of a suture. The patient dying afterward, the autopsy showed that, instead of invaginating the portion of the ilium in the inferior end of the large intestine, it had been inverted to its superior end."

Velpeau's Operation by Anaplasty.—A lady, after undergoing an operation for the closure of a recto-vaginal fistula by means of the suture, was left with a perforation in the lower part of the recto-vaginal partition, above the front of the suture. To close this, a flap two inches long, and eight or ten lines wide at its base, was cut from the tissues about the left labium majus, and a thread being affixed to its upper extremity, it was drawn from the vagina into the fistula in the rectum, so as to be fastened near the anus, Plate LX. Fig. 3. Two-thirds of its extent, however, mortified, and as it adhered only on one of its sides, the fistula was diminished but one-third of its size. Velpeau, nevertheless, thinks that in more tractable patients, and by taking every possible precaution not to weaken the vitality of the flap, such an operation will offer some prospect of success.

SECTION IV.

STONE IN THE FEMALE BLADDER.

As the symptoms and pathology of calculus in the female resemble closely those already described in connection with calculus in the male, it is unnecessary here to do more than describe the means of treatment, and mention the fact that a diagnosis of stone in the female bladder can alone be made by introducing a sound into that viscus, and touching it. In numerous instances a displaced uterus, polypi in the urethra, etc. have presented the rational symptoms of stone when the latter did not exist.

The great dilatability of the female urethra favoring the escape of pebbles of considerable size, the existence of urinary calculus is much more rare in the woman than it is in the man, though it is occasionally seen. Before the revival of lithotripsy, the treatment of such cases was usually accomplished by dilating the urethra, or by opening the bladder at various points, as in the operation of lithotomy in man. Lithotomy in the female is, however, often followed by incontinence of urine and by other evils which do not so frequently ensue in males; and, as most calculi can be removed by crushing, and the easy dilatation of the female urethra especially fits it for this operation, as well as for the passage of large fragments, I do not regard the operation of lithotomy as justifiable in women, except in cases of extremely large calculi.

When a calculus is so large that it nearly fills the bladder, **Lithotomy** may be best performed through the vagina.

§ 1.—Vaginal Lithotomy.

Ordinary Operation.—With the patient etherized, and in the position for lithotomy, pass a straight grooved staff into the bladder, with the groove turned to the vagina, and depress its point until it can be felt in the vagina. With a sharp-pointed bistoury puncture the vagina and bladder at a point fifteen lines from the anterior or vulvar orifice of the urethra, and entering the groove of the staff, cut cleanly backward in the groove, through the inferior fundus of the bladder, for about one inch; pass the forefinger of the left hand promptly into the bladder, and introduce the forceps upon it, withdrawing the stone by cautious movements in the line of the inferior pelvic strait; or, if the calculus is too large to be grasped by the forceps, introduce a lithotriptic instrument, and, crushing it to pieces, wash and scoop out the fragments. After cleansing the bladder thoroughly, unite the edges of the wound by a few stitches of the interrupted metallic suture, as in closing a vaginal fistula, and introducing Sims' catheter, treat the case as a vesico-vaginal fistula. Should a fistula result, treat it as before directed.

The advantage of this method over lithotomy, as usually performed by incising the urethra, or by the high operation, is its comparative freedom from danger, and the subsequent ability of the patient to retain her urine; incontinence often supervening when the urethra has been incised.

§ 2.—Lithectasy in the Female.

Lithectasy in the female will often enable the surgeon to remove small calculi without much difficulty. When the calculus is small, the ordinary polypus forceps may be passed closed into the bladder, opened, and the pebble pushed toward them until seized by a forefinger in the vagina, pressing the bas-fond of the bladder upward and forward. Having seized the pebble in its long diameter, withdraw the forceps very slowly, moving the forceps up and down, as well as laterally, so as gradually to dilate the urethra as the pebble is drawn out. Dilatation of the female urethra may also be accomplished by introducing a small piece of compressed sponge, passes more readily. In health, and in the normal position of the uterus, the sound will follow the normal line of the organ just stated; in retroversion, anteversion, retroflexion or anteflexion, or lateral displacement, it surely indicates the direction of the uterus by following the line of its cavity. As this sound is graduated by inches, it is easy to tell by the touch how far it penetrates the organ. Great gentleness must be employed in manipulating with it in any examination, lest the internal uterine membrane be lacerated and inflammation developed. In establishing the patulous condition of the os and cervix uteri, the position of the body and fundus, and the presence of tumors, this sound is a great addition to the means of diagnosis. If it cannot be had, a bougie may be employed instead. When the sound is passed into the cavity of the healthy uterus, the sensibility corresponds with that of the healthy vagina—complaints of soreness, pain, etc., when the sound is in the cavity of the uterus, may, therefore, be regarded as indicative of a morbid condition. In employing the sound, place the patient on her back, pass the left forefinger to the os uteri, and glide the sound on it as a director. When the instrument is within the uterus, the latter can be carried in any direction, and, with the left hand on the abdomen, the uterus and sound may be felt anteriorly, the presence of tumors noted, etc., without the patient suffering acutely, if gentleness is observed.

Various forms of specula vaginæ are figured in Plate LVIII. In using any of them, it is best to place the patient on her back, with her hips near the edge of the bed, and cover her entire person with a sheet. Then recognizing by the touch the position of the os uteri, place the left forefinger in the vagina so as to depress the fourchette, separate the labia with the second forefinger, and, with the speculum well anointed, pass it along the finger as a guide, and carefully and slowly introduce it by a slight rotary and lateral movement from before backward in the axis of the vagina. As soon as the instrument enters within the sphincter vaginæ muscle, withdraw the left forefinger and fold the sheet carefully around the instrument, so as to cover entirely the patient and leave the right hand of the operator and the instrument uncovered. Then gradually passing the speculum in the axis of the vagina and of the pelvic straits, examine the condition of the vagina as its folds pass before the point of the speculum, varying the position of the instrument until the os is placed fairly in its field. The best speculum for constant use is one of glass coated with quicksilver and covered with cloth and gutta-percha, as suggested by Fergusson, of London. The varnished instrument, so generally sold in the United States in imitation of this, is worthless, being liable to break and to have rough edges. The valved or metallic instruments are useful, but not so easily manipulated and kept clean, while the folds of a relaxed vagina falling into the fissure between the blades of a bivalve instrument are liable to obstruct the view.

In health the vagina and uterus are of a moist pink color—being lightest in virgins. Inflammation changes the shades of this pink to a bright scarlet or deep purple. Such an amount of mucus or pus as will accumulate as the instrument enters, is abnormal. In health there is no apparent discharge from the os uteri, the lips are also smooth and not sensitive, the vagina is moist, but not bathed in fluid. The healthy vaginal mucus, if freely secreted, is white, creamy, and fluid, is acid in its reaction, reddening blue turmeric paper, and, when examined by the microscope, exhibits, as Donne, of Paris, has shown, an epidermal epithelium. The uterine mucus is more viscid and tenacious and alkaline in its reactions, restoring the blue color to red turmeric paper. The variations in position, with the results of inflammatory action in these organs, may be recognized by a comparison with the healthy condition, and will be separately presented.

SECTION I.

DISPLACEMENTS OF THE UTERUS.

The uterus may be displaced by descending into the vagina until the os rests on the perineum—**Prolapsus**—or till it escapes through the vulva—**Procidentia**—or the fundus may fall into the hollow of the sacrum, while the os rises toward the pelvis—**Retroversion**—or the fundus fall toward the pelvis and the os to the sacrum—**Anteversion.** The body may also be bent backward while the neck retains its median position—**Retroflexion**—or it may fall forward—**Anteflexion.** These displacements being unnatural, and the result either of mechanical causes, as blows, falls, straining, etc., or the consequence of chronic inflammation, induration and hypertrophy, or of such congestion as increases the bulk and weight of the organ, have been studied with great accuracy, in view of their influence on the patient's health. Surgeons, however, have differed in their views of the results and causes of displacement, Velpeau, Malgaigne, Huguier, and others regarding uterine displacement as the consequence of mechanical forces, and the cause of the suffering inflammation, and change of tissue often noticed in connection with displacement; while Dubois, Caseau, and other obstetricians think that the inflammation, hypertrophy, etc. preceded and caused the displacement. With such opposite opinions there has been suggested varied and diverse plans of treatment, surgeons generally advocating a mechanical support or resistance to the displaced organ; phycicians regarding the cure of the inflammation and the reduction of hypertrophy of tissue as sufficient in most instances, without a mechanical treatment. As in many other questions, the advocates of each side have probably erred, displacement when present, and however caused, demanding support by artificial means, like *pessaries;* while, as the displacement either causes or supervenes on functional disturbance, a constitutional and local alterative and antiphlogistic treatment will also be required. In England, Bennett is generally opposed to their use, West rather advocates it, and Baker Brown is opposed to it. In the United States there are many who advocate the use of pessaries. That their use has been much abused cannot be doubted; that their entire neglect has led to evil is equally correct. That if long worn they weaken and dilate the vagina, and remove a natural support, creating, sometimes, ulceration of the neck by pressure, is also true. But it must be admitted that chronic inflammation of certain parts is greatly aided by rest in a good position, while, by a judiciously applied pressure, hypertrophy is diminished, or such a stimulus exercised as facilitates a restoration of the normal nutritive action of the affected tissue. Hence I cannot doubt, that when with a displaced uterus we also have induration or hypertrophy of the os and neck, with elongation, increased mucous secretion, pain and the other symptoms of chronic metritis, the application of a well-selected pessary is useful, and cannot augment the evil, especially if combined with internal medicines and local alteratives. On the other hand, when we have simply displacement of the organ with but trifling symptoms of engorgement, increased mucous discharge, abrasion of the epithelium of the mucous membrane of the os and neck, I think the use of a pessary injurious as a general rule, to which we may occasionally find exceptions. In a large number of cases of uterine displacement in virgins, the use of a pessary, by overcoming the normally contracted condition of the vagina, is liable greatly to increase the evil. In married women, where the relaxed condition of the canal and the recurring force of coitus is liable to augment a displacement, the employment of a pessary is often most useful. The selection of an exclusive plan of treatment is here, as in other disorders, therefore very apt to result in evil.

The forms of the pessary have varied considerably—the circular disk, globe, and horseshoe pessary are those most employed in the United States. The intra-uterine or stem pessary of Simpson, with the caoutchouc bottle, etc., have comparatively few advocates in the United States. In the first named, the perineum is the basis of support, the anterior or posterior portion of the neck the part sustained. As the distance between these points varies in different cases, the length and width of the pessary resorted to must also vary. Usually a pessary that moves freely in the vagina is too small, and one that creates a sense of distention and pressure too large. When, after its introduction, there is a sense of bracing and increased strength, with no annoyance from the bladder or rectum within six hours after its application, the instrument has been well selected and judiciously placed. The various modifications of the disk pessary are the best, Plate LVIII. Figs. 17, 18, 19, being easy to introduce and withdraw, and not interfering materially with marital rights, this being often a serious ethical question.

Operation.—To introduce a pessary, place the patient on her back or left side, depress the fourchette with the forefinger, and, gently pressing the pessary backward and upward, slip it inside the sphincter vaginæ muscle in the line of the axis of the vagina. In marked prolapsus and retroversion, place the upper edge of the pessary behind the neck of the uterus in the vaginal cul-de-sac. In marked anteversion, when seen, it may perhaps be necessary to place it, for a few hours, anterior to the os, provided it does not irritate the bladder. Usually carrying the os and neck forward, by placing the pessary behind them, answers all that is required even in anteversion; as the fundus will then fall in the opposite direction. While the pessary is in place, cold injections into the vagina of soap and water or a mild astringent should be daily practiced. When the pessary is finally removed, rest in bed for a few days and astringent washes will be useful, and prevent the feeling sometimes induced by the removal of the instrument, a sensation analogous to that caused by the removal of a splint that has been worn for some time in the case of a fractured bone. Metallic pessaries are generally preferable to glass, which might be accidentally broken, and are not so liable to become offensive as the instruments made of or covered with gutta-percha and caoutchouc, unless these articles are vulcanized.

In removing a pessary, reverse the manipulation, hooking it down with the point of the forefinger, withdrawing it through the orifice of the vagina on the axis of the canal. With a very considerable experience in the use of pessaries as an adjuvant to other plans of treatment in the disorders of the womb, I have seldom, if ever, seen inflammation, ulceration, or irritation caused by one well selected and fitted to the condition, and I have had patients to wear them as long as three years without professional attendance; daily vaginal injections being carefully practiced. Where a large and long instrument has been employed, or one with too long a curve in the horseshoe variety, so as to press very forcibly on the neck of the uterus, I have occasionally seen the instrument a source of inflammation. But this is only evidence of the defects of the practitioner, and not of the instrument. When carefully fitted to the length and width of the vagina, a pessary will often prove a valuable adjuvant to other measures in the treatment of these disorders, and especially when the displacement is due to a hypertrophy of the organ.

The various forms of abdominal supporters for the relief of displacements of the uterus are undeserving of mention, as anatomically incorrect in principle. The perineal supports in procidentia and marked prolapsus are often useful, either alone or as additions to vaginal supports or pessaries. If an artificial uterine support is deemed essential, or even an auxiliary to the case, as it often is, the best in my experience is the disk pessary, or some of its modifications. That which I have most frequently employed is known in the United States as Hodge's pessary, Plate LVIII. Fig. 19, being sanctioned and largely employed in the extended experience of my colleague, the Professor of Obstetrics in the University of Pennsylvania.

When the displacement of the uterus amounts to marked procidentia, and when its duration has created such relaxation of the vagina and perineal muscles as renders the treatment by a pessary or perineal bandage imperfect, the operation of **Episoraphy** has been practiced, and may be thus performed :—

Ordinary Operation of Episoraphy.—Dilating the vagina, either by Sims' speculum, Plate LVIII. Figs. 1, 2, or a bivalve, dissect carefully two or more longitudinal strips of mucous membrane from the vagina. After the hemorrhage has ceased, unite the adjacent raw edges by a few stitches of the interrupted metallic suture until union occurs, which will usually require from four to nine days. As the lower portion of the vagina is thus made to cicatrize longitudinally, the contracted canal offers usually an insuperable obstacle to the escape of the uterus.

Geddes, of Charleston, in bad procidentia uteri obliterated the vaginal orifice, by paring the skin from the margin of the labia and stitching the freshened surfaces together, leaving an orifice for the escape of the menses, etc., when demanded.

SECTION II.

PUNCTURE OF THE UTERUS.

Puncture of the Neck of the Uterus is an operation that may be required by various circumstances, but is mainly demanded in cases where, from mechanical causes, such a degree of inflammation has been excited as has led to the closure of the os uteri. Occasionally the obliteration of the mouth of the uterus is congenital, but in many instances it is simply closed by an adventitious membrane. The restoration of its patulous condition, or the formation of a new orifice, must therefore be regulated by the peculiarity of each case.

Puncture of the uterus may be accomplished by means of a sound, pushed steadily into its cavity if the obstruction is slight and the orifice otherwise normal; though, in more difficult cases, the use of the speculum, with a guarded bistoury, Plate LXI. Figs. 3, 4, 5, or the trocar and canula, will be requisite. Under any circumstances, when the perforation is made, care should be taken to preserve the continuance of the opening by the use of bougies or sponge-tents.

SECTION III.

POLYPI OF THE UTERUS.

Polypi of the Womb, like those found elsewhere, present us with a peculiar class of tumors, whose characteristics are mainly dependent on the mucous membrane to which they are attached, the specific peculiarities of which have been already described.* When developed in the womb, polypi may be removed by very much the same means as were detailed as applicable to them when seated in the nostril, the chief difference being due either to the structure of the part, or to the great size sometimes attained by polypi in this organ. In some cases, uterine polypi have attained a very great size, an instance of which is reported† by O'Keefe, of Georgia, in a case which occurred in the practice of King, of Alabama, where the tumor after removal weighed three pounds. H. H. Campbell, of the same State, also reports a case, in which the tumor was the size of a child's head. When uterine polypi attain this size, it may be necessary to act upon them piecemeal, and so to modify the operations practiced on the same class of tumors in the nostril, as to permit their more ready extirpation. Repeated punctures, so as to evacuate the blood from the mass, with the long-continued use of astringents, or the formation of sloughs by the application of the actual cautery, may all, therefore, be made to precede the entire removal of these tumors by the ligature or knife. The strangulation of uterine polypi by the ligature being, however, the safest as well as the most common method of removing these tumors from the womb, especially when they are pedunculated, it will be taken as illustrating the principal operation demanded for their cure, though it is liable to the serious objection of causing irritation by the discharge from the tumor while it is sloughing, as well as of inducing a tardy removal of the tumor. For these reasons many prefer excision, disregarding the hemorrhage.

I. **Ligature.**—By means of the double canula, a loop of a wire ligature may be drawn tight enough to strangulate the tumor in the following manner:—

Operation.—Place the patient on her back, with the knees drawn up; introduce the speculum so as fully to dilate the vagina; and, recognizing the position of the os uteri, pass the canula—Plate LVIII. Fig. 21—and loop of the ligature over the polypus to the mouth of the uterus by means of a probe, so as to place the loop as high up as possible. Then, while an assistant retains the loop in position by means of the probe, draw upon the wire so as to strangulate the tumor and leave it to slough off, tightening the ligature, from day to day, by means of the screw of the instrument.

Another mode of strangulating uterine polypi is shown in Plate LX. Fig. 4. Should the hemorrhage resulting from any mode of operating be profuse, it may be checked by the application of the tampon or the use of astringents.

Excision of Polypi may be accomplished by seizing them with forceps, and removing them either with the bistoury or scissors.

In a large fibrous polypus of long standing in a patient under the care of H. L. Hodge, of Philadelphia, I succeeded in excising the mass by introducing the finger into the womb, passing a bistoury along it, incising the substance of the tumor, and scooping it out piecemeal by the finger and instruments; the mass removed filling a good-sized soap-dish of a toilet table. The cure was perfect. The dilatability of the os uteri, in many cases of fibrous polypi, especially when the patient is near the termination of the menstrual period, renders it quite possible to enucleate tumors under similar circumstances, the mass of it yielding to pressure as soon as the mucous covering is opened.

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* See Operations on the Nostrils, vol. i. p. 343.

† Report of Committee on Surgery to Med. Society of Georgia.

SECTION IV.

AMPUTATION OF THE NECK OF THE UTERUS.

Excision or Amputation of the Neck of the Uterus has been frequently performed for the relief of carcinomatous affections of this part, and though similar in its results to the operations for cancer seated elsewhere, and only furnishing temporary relief, yet in some cases even this may become a matter of consequence, and the surgeon may therefore desire to perform the operation, though not anticipating the accomplishment of a cure.

Operation of Lisfranc.—The woman being placed in the position for lithotomy, before a good light, the vagina should be dilated by a bivalve speculum, the diseased neck of the uterus seized by Museux's long hooked forceps, or by a pair of tumor forceps, Plate I. Fig. 19, with handles ten inches long, and steady traction made upon them, until the uterus is forcibly prolapsed and brought near to the orifice of the vagina, when its neck may be excised either by a probe-pointed bistoury or by a pair of scissors curved on the flat, as was done by Dupuytren. The hemorrhage, which is often very profuse, should be checked by plugging the vagina.

Amputation of a Uterus.—"Sims, of New York, has recently amputated an entire uterus with the Écraseur of Chassaignac. The case was one of procidentia, in which the uterus had been for a long time entirely inverted, and could not be forced back into the pelvis. No hemorrhage followed, excepting from a vessel connected with one of the broad ligaments, which was afterward ligated. The patient rapidly recovered."*

Chassaignac's Operation for Excision of the Neck of the Uterus.†—Place the patient on the edge of a bed, in the position for lithotomy, and introduce a bivalve speculum, depressing it well posteriorly. Then seize and implant firmly, as high up the neck of the uterus as possible, double hooks, or the forceps of Museux, and draw the uterus sufficiently toward the orifice of the vagina to permit the application of the loop of the écraseur. Then slowly constricting the chain of the écraseur, the entire neck will be amputated without the loss of "a single drop of blood."

Remarks.—Having repeatedly witnessed Lisfranc's operations, I am satisfied that the excision of the neck of the uterus by cutting instruments, when once performed, will prove so serious and troublesome that its repetition will be attempted with great unwillingness by any surgeon. The most dangerous hemorrhage supervened in all the cases that I witnessed, and in several (about four) Lisfranc was compelled to defer the operation. Nor has his success been such as would induce any one who is familiar with the true results of operations for cancer, to rely upon the permanency of the relief which it can afford. Excision of the neck of the uterus has, however, been performed in the United States by Jameson, of Baltimore, in 1824; Strachn, of Virginia, in 1829; Warren, Sr., of Boston, in the same year; N. J. McL. Moore, of New Hampshire, in 1847; Atlee, of Philadelphia, in 1848; Eve, of Georgia, in 1850; Usher Parsons, of Rhode Island, in 1852; and Ogier, of Charleston, also in 1852; but as the results of these operations have not been tabulated, it is difficult to estimate their success. In thirty-six cases, Lisfranc was much troubled by the hemorrhage;‡ two of his patients died of peritonitis, two under cancer of the spleen or liver, and eleven sunk under more or less speedy relapses. If, then, it is desired to get rid of a cervix uteri, I should prefer attempting it by the application of the écraseur, as above described.

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* Cincinnati Lancet and Observer, Feb., 1860.

† Chassaignac, op. cit., p. 283.

‡ Malgaigne.

SECTION V.

EXTIRPATION OF THE WOMB.

The complete **Extirpation of the Uterus** has been accomplished by Essellman, of Nashville, by means of the ligature applied on the inverted uterus, while this organ has also been excised by Paul F. Eve, of Georgia.

Complete Extirpation of the Uterus by Ligature, after Chronic Inversion of the Organ, by John M. Essellman, of Nashville.—A lady, thirty-two years of age, had labored under inversion of the uterus for several years, in consequence of the manipulation of an old woman. Various symptoms inducing the belief in the existence of a polypus, a ligature of saddler's silk, well waxed, was applied around the tumor and tied tight, causing great pain and prostration for the first four or five hours, her pulse sinking to a mere thread. Reaction ensuing, she rested well the first night; and the ligature was tightened each morning for eighteen days, at which time the tumor came away, proving, to the surprise of all who saw it, to be the uterus instead of a polypus.* The patient did not leave her bed for months after the operation, "but was finally restored to perfect health."

Operation of Eve, of Georgia.†—A negro woman, twenty-eight years of age, married, but never pregnant, had been laboring for a long period under a malignant tumor of the uterus, to cure which she consented to excision of a part, or the whole of the womb.

Operation.—The bowels and bladder having been thoroughly evacuated, the patient was put fully under the influence of chloroform, the tumor drawn down to the os externum by forceps, and then the mass carefully excised from above downward, or in an antero-posterior direction, by the knife, it being suspected at the time that the uterus was involved. One artery bled quite vigorously, but it was tied, and the hemorrhage arrested by a solution of the sulphate of zinc. There was no protrusion of the bowels, or any severe symptoms; a rigid diet and the horizontal position were maintained for ten days, and the opening into the peritoneum was closed by agglutination and adhesion.

The uterus, with the Fallopian tubes and broad and round ligaments, could be distinctly seen in the mass.

SECTION VI.

EXTIRPATION OF THE OVARY, OR OVARIOTOMY.

When the ovary has been the seat of such changes as have induced a degeneration of structure, and especially when it has resulted in the formation of a cyst or other tumor, it has been proposed, within the last century, to remove the entire mass by means of an incision through the abdominal parietes. Such an operation is not as difficult as it is dangerous from its subsequent effects, and the prognosis should, therefore, be well considered before the operation is attempted.

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* Amer. Journ. Med. Sciences, vol. vii. N. S. p. 254, 1844.

† Ibid., vol. xx. N. S. p. 399, 1850.

Ovariotomy may be accomplished by an incision into the abdominal parietes, of sufficient extent to permit the escape of the mass. As the diagnosis is not easy, and the size of the tumor varies considerably under different circumstances, two operations have been described, and have been designated as the great and lesser operation, the distinction being chiefly owing to the length of the external wound.

In the Minor, or exploratory operation, or that proposed by William Hunter, the incision should be about two inches long, and the ovarium tapped, or the condition of the part, and especially the extent of the adhesions, learned by introducing the finger through the small wound. The Major operation lays open the abdomen from the umbilicus, or even beyond it, to within an inch and a half or two inches of the pubis, so as make the cut from eighteen to twenty-four inches long. The minor operation is palliative, or intended to assist the diagnosis, while the major is for the removal of the mass.

§ 1.—The Major Operation.

Operation of McDowell, of Kentucky.*—In December, 1809, a patient, with an enlarged ovarium, was operated on as follows: Being placed on a table of the ordinary height, and all the dress removed that could impede the operation, an incision was made in the abdomen, parallel with the line of the rectus abdominis muscle, but about three inches from it on the left side, and extended from the margin of the ribs to the pubis.† On opening the abdomen, its parietes were found to be a good deal contused from the tumor having rested on the pommel of a saddle, on which the patient had traveled. The tumor, after being fully exposed, being found to be too large to be removed entire, a strong ligature was placed around the Fallopian tube near to the uterus, and the tumor cut open, Plate LXI. Fig. 1, when it was proved to consist of the ovarium and fimbriated extremity of the Fallopian tube. About fifteen pounds of a dirty, gelatinous-looking substance being evacuated, the Fallopian tube was divided, and the sac, which weighed seven pounds and a half, extracted.

As soon as the external incision was made, the intestines fell out on the table, and could not be replaced during the operation, which lasted twenty-five minutes. The patient was, therefore, placed on the left side, so as to permit the blood to escape, after which the intestines were replaced, and the wound closed by the interrupted suture, the ligature around the Fallopian tube being left out of its lower angle. Between every two stitches there was placed a strip of adhesive plaster, which aided the union, and after applying the usual dressings, the patient was put to bed, kept on a strict regimen, and in twenty-five days returned to her home, which was sixty miles off. The patient was a Mrs. Crawford, of Kentucky, and subsequently of Indiana, where she died in 1841—thirty years after the operation—in the 79th year of her age, having enjoyed excellent health up to the period of her death. She had no children after the operation.‡ Of ten cases operated on by McDowell, eight were cured.

Operation of Atlee, of Philadelphia.§—**Preparatory Measures.**—The diagnosis being carefully established, the bowels and bladder should be evacuated, the room warmed to the temperature of 80° Fahr., the finger-nails of the operator and his assistants trimmed close, and the following instru-

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* Eclec. Repert. and Analyt. Review, vol. vii. p. 242, 1817.

† Ibid., vol. ix. p. 547.

‡ Gross, History of Kentucky Surg., p. 8.

§ Am. Journ. Med. Sciences, vol. viii. N. S. p. 51.

PLATE LXI.

OPERATIONS ON THE FEMALE GENITO-URINARY ORGANS.

Fig. 1. McDowell's Operation for Ovariotomy. An incision has been made through the linea alba, the abdomen opened, and a ligature passed around the pedicle of the tumor, near to its uterine extremity. The hands of the assistants are seen retaining the tumor in position, while the surgeon, grasping the section of the broad ligament of the uterus, is about to divide it with the scalpel, beyond the ligature, so as to avoid unnecessary hemorrhage. 1, 1. Hands of the assistants. 2, 2. Those of the operator. *After Bourgery and Jacob.*

Fig. 2. Extirpation of the Uterus by means of the Ligature, in a case of procidentia uteri. The uterus and the vagina having been prolapsed beyond the vulva, and the viscera which had been invaginated in the utero-vaginal pouch having been reduced, an assistant kneels below the operator, and seizes the vagina and uterus between his thumbs and fingers, 1, 1, in order to prevent their escape, while the surgeon passes a needle, with a double ligature, vertically through the vagina, ties the right half, and is about to tie that on the left, the ends of which are seen pendent. *After Bourgery and Jacob.*

Figs. 3, 4. Uterotomy, or incision of the neck of the uterus, either by a straight or curved bistoury, in order to enlarge the os uteri and facilitate the extraction of a polypus. *After Bourgery and Jacob.*

Fig. 5. Section of the abdominal parietes, in order to show the operation of puncturing the os uteri, when it is requisite to evacuate the menstrual secretion. 1. Left hand of the surgeon, as placed upon the hypogastrium, in order to steady the uterus. 2. The right hand of the surgeon, holding the trocar, and directing its point upon the right forefinger, which is curved so as to carry it to the position of the os uteri. *After Bourgery and Jacob.*

Plate 61

Fig. 1

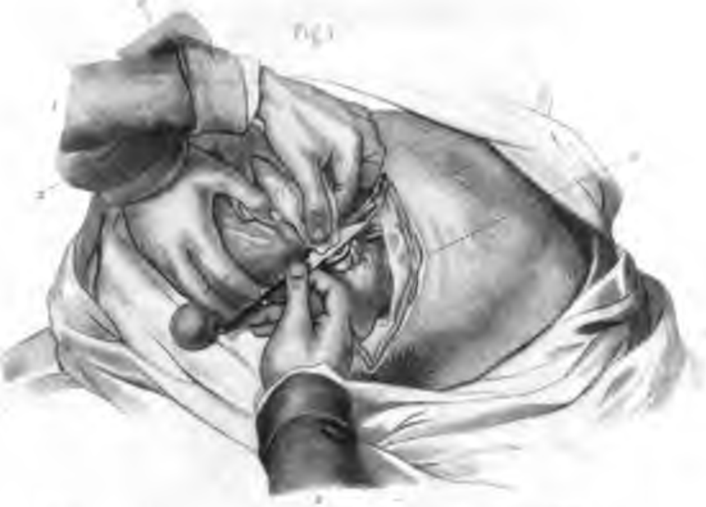


Fig. 4.

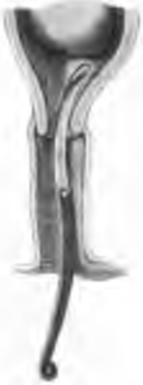


Fig. 2

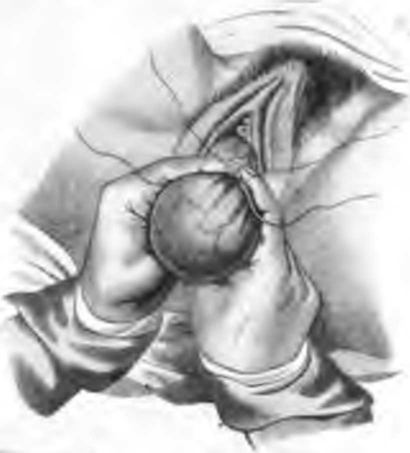


Fig. 3

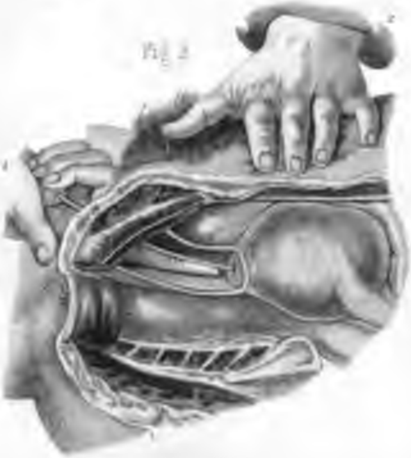
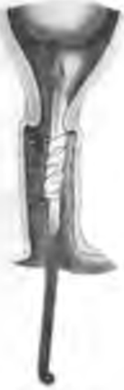


Fig. 5



ments placed upon a tray, to wit: two good and large scalpels for the abdominal incision, one probe-pointed bistoury, one director, one tenaculum, two dissecting forceps, one pair of dressing forceps, together with ligatures, sponges, towels, brandy, etc., a narrow table being also well covered and placed in a good light, with two chairs to receive the patient's feet.

Operation.—The patient, clothed in an ordinary nightgown, rolled up around the waist, being placed upon her back upon the table, with her hips near the end, and covered by a sheet, applied like a diaper, her feet are to be supported by two chairs, her limbs covered with another sheet, and her head and shoulders moderately raised. The surgeon should then place himself upon the patient's right ride, and commencing an incision immediately below the umbilicus, carry it boldly through the skin and subcutaneous tissues to the sheath of the recti muscles, extending the incision in the median line to within one inch of the symphysis pubis. A small incision being then made through the linea alba, the peritoneum is to be cautiously cut and opened to the extent of the external wound by means of the probe-pointed bistoury.

The hand being now introduced into the abdominal cavity, the connections of the tumor should be examined, and an effort made to tilt it out, when, if the abdominal opening is too small, the incision may be continued below to the pubis, and above to three inches beyond the umbilicus, passing around the latter on its left side. The tumor being then turned out on the side opposite to its pedicle, the latter was found, in the case operated on, to consist of a broad ligamentous sheath five or six inches broad, extending from the left hypochondrium into the pelvis; had the sigmoid flexure of the colon incorporated in it; was highly vascular, one vein as large as a goose-quill, extending along its attachments, and sending out ramifications which were much gorged with blood. This pedicle consisted of a double fold of peritoneum, arose from the broad ligament of the uterus, had a triangular form, and its lower edge, which ran from the uterus to the left side of the pelvis, was several inches long, while the upper, which ran from the tumor to the uplifted sigmoid flexure, was one inch long. The Fallopian tube, which was also very much elongated and somewhat attenuated, was stretched up to the top of the tumor.

A surgeon's needle, armed with a single strand of saddler's silk, being waxed, was now passed so as to include an inch of the lower border of the pedicle, and firmly tied, after which this part of the pedicle was divided near the tumor, exposing some of the large veins upon its surface, which broke as soon as they were deprived of their peritoneal coat, and gave rise to most of the hemorrhage that was seen. A second ligature of double-stranded silk was then introduced about an inch above the first, made to embrace several veins, and being then firmly tied, the remainder of the pedicle was tied with another ligature, and then severed, when the whole tumor was removed. The blood which flowed into the pelvis did not exceed six ounces, and was carefully removed by soft and warm sponges. The ends of the pedicle being then examined, and no oozing noticed, the four ligatures were brought out at the lower end of the wound, and the latter closed by nine hare-lip sutures and intervening adhesive strips, covered by patent lint and a soft compress, and the whole secured by a broad towel, which extended from the thorax to the trochanters. The operation occupied about an hour; peritonitis supervened, and death ensued on the fifth day.

Statistics of the Operation.—The formation of tables showing the results of the operation of ovariotomy has, fortunately for the profession, been well attended to; but the question of its success up to this period is not definitely settled. The following table, expressive of the opinions of Simpson, of Edinburgh, shows the present position of the question:—

SIMPSON'S VIEWS ON OVARIOTOMY.*

OBJECTIONS.	ANSWERS.
1. It is a dangerous operation.	1. But not more so than other capital operations, as amputation at hip, etc.
2. The operation is as fatal now as it was at first; does not diminish in fatality with the progress of medicine.	2. This idea is erroneous; the per cent. of mortality is diminishing, as shown by the statistics of Atlee and Clay.
3. The disease is liable to return after the operation.	3. It is really very seldom that it does so, much less frequently than is the case for very many other operations.
4. The condition of the patient is not improved.	4. It is improved in very many cases; and, if not in all, this is also true of many other surgical operations.

Mortality after Ovariotomy, and after various other Capital Operations.†

Reporter.	Nature of operation.	Cases.	Deaths.	Proportion of deaths.
Fock	Ovariotomy	292	120	41 in 100, or 1 in $2\frac{1}{2}$.
Atlee	"	179	59	33 in 100, or over 1 in 3.
Simon.......	"	44	32	73 in 100, or 1 in $1\frac{3}{8}$.
Clay	"	93	29	31 in 100, or 1 in $3\frac{1}{5}$.
Peacock	Amputation of limbs.......	72	35	49 in 100, or 1 in 2.
Cooper and Inman	Herniotomy	622	296	47 in 100, or 1 in $2\frac{1}{10}$.
Various surgeons..	Ligation of innominata artery	14	14	All those operated on have died.
Inman	Ligation of subclavian......	40	18	45 in 100, or nearly 1 in $2\frac{7}{10}$.
Inman and Phillips....	Ligation of other large arteries.....................	370	123	33 in 100, or 1 in 3.
Cox..........	Amputation at hip-joint for chronic disease......	24	18	75 in 100, or 1 in $1\frac{1}{3}$.
Malgaigne.	Amputation of limbs.......	852	332	33 in 100, or over 1 in 3.
Malgaigne.	" of thigh.......	200	122	61 in 100, or 1 in $1\frac{3}{5}$.
Lawrie.......	" of limbs.......	276	101	36·6 in 100, or 1 in $2\frac{7}{10}$.
Fenwick	" "	4937	1565	32 in 100, or 1 in $3\frac{1}{15}$.

The candid inquirer after truth may also realize the position of this question by laying aside all preconceived opinions, and examining it under the following or similar heads:—

1. Are such tumors proper subjects for an operation?
2. Is their removal attended by any extraordinary difficulty or danger during or after the operation?

I. **Are Ovarian Tumors proper subjects for an Operation?**—In investigating the merits of ovariotomy, this question stands prominently forward, and must mainly regulate an opinion of the value of the operation.

To show the sentiments of a few experienced surgeons, I cite the following opinions:—

Velpeau‡ says: "The diseases which require ovariotomy are, if left to the resources of nature, almost always fatal; but, though incurable, they do not generally cause death until after a long-protracted period, which lasts, as a medium, five or six years." Under certain conditions, such as the medium size and mobility of the tumor, he deems them proper subjects for the operation.

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* From a Clinical Lecture, Medical Times and Gazette, (see Maryland and Virginia Medical Journal, May, 1860.)

† From a Clinical Lecture of Simpson, of Edinburgh, Medical Times and Gazette, (see Maryland and Virginia Medical Journal, May, 1860.)

‡ Velpeau, Operat. Surgery, by Mott and Townsend, vol. iii. pp. 538, 539.

Churchill* thinks "there are cases in which this operation would be justifiable on the grounds that the disease is incurable by medical means; that the patient will ultimately die from constitutional disturbance after suffering more or less inconvenience; and that tapping in ovarian dropsy is attended with great danger."

Colombat,† who seems to be least decided in his views, says: "Without wishing to proscribe the operation, it ought not to be resorted to, except as an extreme resource."

Chelius‡ thinks, "unless the disease causes great annoyance, no operation is allowable; but puncture only affords a short relief, as the fluid re-collects so much the quicker the oftener it is evacuated."

Blundell§ says: "We may be justified in operating, provided it be the wish of the patient." But he also says:‖ "All the operations upon the ovaries are worthy of consideration; for, if one can be made to cure an unhappy individual, who would otherwise fall a victim to disease, it will be an invaluable good to the fairest and least offending part of our species."

From an examination of these opinions—and they are certainly those of great professional worth, and might be readily augmented, did my space permit—we are, I think, justified in concluding that the majority of ovarian tumors cannot be controlled by medicine; that their natural course is to terminate fatally in about five years; that tapping them is attended with considerable danger; and that, when they create great distress to the patient, and the latter is fully informed of the probability of failure and the chance of death, such tumors may, as a forlorn hope, be regarded as occasionally proper subjects for an operation.

II. Is the Removal of an Ovarian Tumor attended by any extraordinary difficulty or danger during or after the Operation?—In attempting to decide this portion of the question, little more than a general opinion can be given, as individual cases will often be found in this disease, as in others, in which peculiar difficulties must be overcome. As a general rule, the dangers attending the removal of ovarian tumors are mainly due to the error of diagnosis, it being almost impossible to foretell the condition of the attachments of the tumors; and yet, though many such instances are on record, there are a number of cases in which the diagnosis was correct and the operation successful.

Thus, "out of 81 cases collected by B. Phillips, in 1844, in which ovariotomy was attempted, no tumor was found in 5, and in 6 others it was not ovarian;" and "in 15 of the 81 cases it was impossible to remove the tumor after the abdomen was opened, owing to the adhesions,"¶ though of these 9 recovered. Of the 81 cases, 49 recovered and 32 died. Of 61 in whom the tumor was extracted, 35 recovered and 26 died.

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* Notes on Ovariotomy, quoted from Meigs's Colombat, p. 418.

† Diseases of Females, Meigs's translation, p. 432.

‡ Chelius's Surgery, by South, vol. iii. p. 212.

§ Diseases of Women, p. 118, quoted from Churchill, Phila. edit. p. 304.

‖ Churchill, p 305.

¶ Druitt's Operat. Surgery, Phila. edit. p. 422, 1848.

PLATE LXII.

OPERATIONS UPON THE UTERUS THROUGH THE ABDOMEN.

Fig. 1. **Langenbeck's Operation for Extirpation of the Uterus.** An incision having been made through the linea alba, the hands, 1, 1, of two assistants elongate the angles of the wound, and retain the intestines in the abdomen, while the surgeon, after applying a ligature to the broad ligaments of each side, seizes the womb with 2, his left hand, and is about to extirpate it above the vagina with the knife, 3, in his right hand.

After Bourgery and Jacob.

Fig. 2. A view of the Cæsarean Operation. The incision having been carried from just below the umbilicus to a little above the pubis, the abdominal parietes and the peritoneum have been divided in the line of the linea alba, the uterus opened, and while 1, the left hand of the surgeon, separates the right lip of the abdominal wound, the right hand, 2, has seized the head of the fœtus, which presented in this instance, and is about to deliver the child.

After Bourgery and Jacob.

Plate [illegible]

Fig. 1

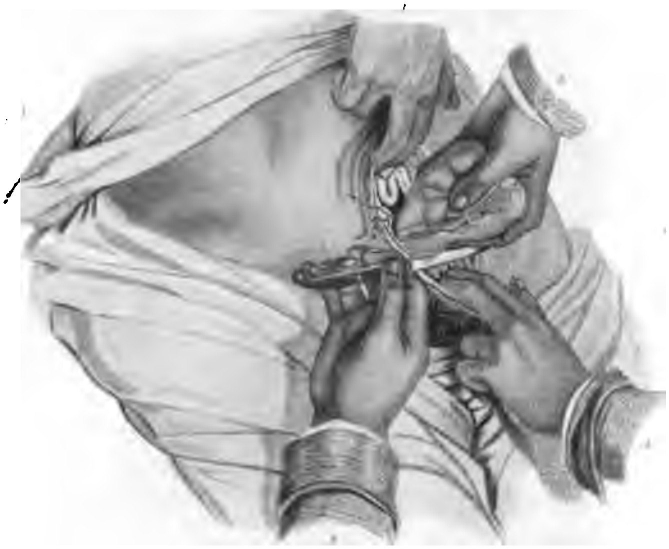
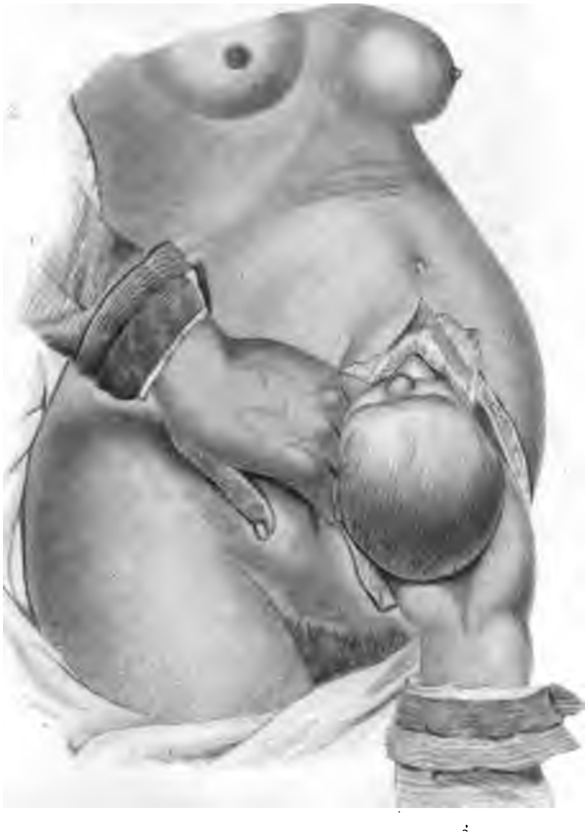


Fig. 2



SECTION VII.

ON THE CÆSAREAN OPERATION.

The term **Cæsarean Operation** has, from a very early period, been assigned to that in which the parietes of the womb were incised through the walls of the abdomen, in order to permit the removal of the child in this manner when the pelvis was too small or deformed to allow of its delivery *per vias naturales.* Few of the operations proposed for the benefit of mankind present the surgeon with as many scruples in regard to the course to be pursued as this; and he may well hesitate before deciding upon an operation which, though it may offer a prospect of saving the life of the infant, exposes the mother to almost certain death. As the preservation of the life of the child is also by no means certain, the surgeon, when thus called upon, should endeavor to weigh correctly the value of each life to society, and, if satisfied of the greater value of that of the mother, remove the child piecemeal through the vagina. In Paris, as stated by Velpeau,* every woman died on whom it was performed during forty years, and in Great Britain there had been no well-attested cure, as reported by S. Cooper. Out of 424 others reported by other surgeons, as occurring elsewhere, 210 died, making the chances of success about one out of two, supposing all the accounts to be accurate, but yet presenting a fearful odds when it is remembered that the delivery may be accomplished without risking the life of the mother more than in many instrumental deliveries. In the United States, the operation has been performed in a few instances with nearly similar want of success, though it was attended by a most fortunate termination in the patient operated on by Gibson, of Philadelphia,† and on whom it was performed twice, thus proving successful in two different pregnancies. Jeter, of Georgia, in 1852 also operated successfully on a patient thirty years old,‡ and Byrd Page and Neill, of Philadelphia, have each successfully accomplished the same thing.

Preparatory Measures.—The operation having been decided on, there should be prepared one or two good large scalpels, one sharp and one probe-pointed bistoury, dissecting forceps, dressing forceps, a director, scissors, hare-lip pins, ligatures, a syringe, catheter, brandy, ammonia, sponges, adhesive strips, spread cerate, compresses, and bandages. The abdomen should also be entirely free from hair, and the rectum and bladder thoroughly evacuated. The arrangement of the bed or table, as directed in lithotripsy, will usually be useful in this operation.

Ordinary Operation.—The patient being etherized, so as to tranquilize the bowels, two assistants should compress the abdomen with their hands, so as to steady the uterus, and prevent its variation from the abdominal parietes. The surgeon then, with a large scalpel, should incise the integuments in the line of the linea alba from just below the umbilicus to within about one inch of the pubis, not passing too near the latter, in consequence of the position of the bladder, and passing on the left of the umbilicus, if he extends the incision upward, in order to avoid the anastomosis between the epigastric and umbilical veins. The abdominal parietes being thus divided, the peritoneum should be punctured, the left forefinger introduced as a director, and the membrane slit up with the probe-pointed bistoury, to the extent of the outer incision. The uterus, being now fully exposed, should be cautiously incised, layer by layer, until the membranes around the fœtus are exposed, when an assistant should rupture them, if possible, per vaginam; but if not, the sides of the abdomen should be closely pressed against the womb, and the liquor amnii discharged through the wound. Two assistants should now hook up the uterus with their fingers at the angles of the wound, in order to prevent its variation from the external incision, and the surgeon then extract the child according to its position, Plate LXII. Fig. 2; the membranes and placenta being subsequently removed per vaginam, or through the wound, according to circumstances.

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* Op. Surg., loc. cit.

† Am. Journ. Med. Sciences, vol. xvi. 1835, and vol. xxii. 1838.

‡ Transact. Med. Society of Georgia. Report on Surgery, in the Southern Journal of Med., vol. viii. p. 744.

The parts being now thoroughly cleansed, and any clots that may have collected washed out through the vagina, by means of the syringe and catheter, the bleeding vessels may be ligated, if the uterine contraction is not sufficient to arrest the flow of blood. A strip of linen should then be placed in the pubic angle of the abdominal wound, and the sides of the latter united by the hare-lip suture and strips, the uterine contractions diminishing and closing the opening in that organ. Spread cerate, a compress, and a body-bandage complete the dressing, when opiates may be administered, and an appropriate after-treatment directed, in order to combat peritoneal inflammation.

CHAPTER IX.

DISORDERS OF, AND OPERATIONS PRACTICED ON, THE RECTUM.

SECTION I.

SURGICAL ANATOMY OF THE RECTUM.

Arising at the inferior and left side of the fifth lumbar vertebra, the rectum descends obliquely downward to the centre of the sacrum, and following thence the middle line of the bones, it terminates near the point of the coccyx, in the anus. Although nearly cylindrical in its entire length, the rectum yet presents a considerable dilatation or pouch near its lower end.

The rectum has the same number of coats as the other intestines, but its inferior third is not covered by the peritoneum. In man, it corresponds with the position of the bas-fond of the bladder, vesiculæ seminales, prostate gland, and membranous portion of the urethra, to all of which it is very loosely attached by its anterior face; but in the female, it adheres directly and closely to the posterior face of the vagina.*

The peritoneum stops about two inches from the end of the rectum in woman, but it is from two to three inches above the anus in man.†

The muscular coat of the rectum, like that of the other intestines, is composed of circular and longitudinal fibres; but when the latter reach the lower margin of the anus, they do not terminate, but turn under it between the internal and external sphincters, and then ascend in contact with the mucous coat, or the submucous cellular tissue, into which they are finally inserted. This connection exerts considerable influence on the mucous coat in hemorrhoids, as well as in prolapsus ani.

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* Dict. de Méd., tome xxvii. p. 271.

† Malgaigne.

The mucous coat at the lower end of the rectum is thrown into longitudinal folds—columns—at the lower end of which are numerous small pouches of from two to four lines in depth, which point upward, and are occasionally the seat of a disease—encysted rectum—which is characterized by intense itching.*

The arteries of the rectum are known as the hemorrhoidal, and are sufficiently large and numerous, about an inch and a half from the anus, to cause troublesome hemorrhage. When diseased, the flow of blood from them is apt to be profuse, even when they are divided near the anus.

The hemorrhoidal veins are very numerous, and form, at the lower part of the gut between the mucous and muscular coat, the hemorrhoidal plexus, which anastomoses freely with the adjacent veins, all of which are without valves. The thinness of the mucous coat over these veins gives to internal hemorrhoids the very smooth, shining, and bluish or purple tint which is characteristic of this complaint

On the exterior face of the rectum, the hemorrhoidal plexus is applied to the internal sphincter muscle, and branches of it pass through the muscle in so many directions that its fibres are sometimes, and especially in bad cases of hemorrhoids, so intermixed with enlarged veins as to appear like an erectile tissue.†

The orifice of the rectum (anus) is closed by a sphincter muscle, which is under the control of the will; the contraction of which has an effect in producing the folds or wrinkles found in the skin about the anus, while its relaxation permits, in certain diseased conditions, the eversion of the mucous coat, together with the blood-vessels and nerves. Even in the ordinary evacuation of the bowel, the loose adhesion of the mucous to the adjacent tissues permits the formation of a circular pad which is formed of the inverted portion of the gut, and favors the escape of the fecal contents by forcing the matter to free itself from the surface of the bowel, while the skin of the part is thus protected from contact with the discharges, when of the ordinary solidity. Certain diseased conditions change this action, as will be again referred to under the operations for fissure and prolapsus ani.

SECTION II.

DISORDERS OF THE ANUS.

The skin covering the margin of the **Anus** is liable, like the skin of other portions of the body, to the development of inflammatory action, which is here aggravated both by the friction of the cheek of one buttock against the other, as well as by the constant passage of the feces over it. In addition to the ordinary results of inflammation of the skin, as congestion, suppuration, and ulceration, the integuments of the anus are especially liable to a form of vesicular disease that constitutes a true eczema—is the source of great annoyance to the patient, and is not unfrequently regarded as due to disease within the rectum, instead of being, as it frequently is, purely an external disorder of this region, though perhaps first excited by irritating discharges from the rectum.

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* Horner's Anat., vol. ii. p. 47, 9th edit. 1851.

† Dict. de Méd., tome xxvii. p. 274.

§ 1.—Eczema of the Anus.

Symptoms.—Eczema of the anus, like the eczema of other regions, is seen either as an acute, or, more frequently, as a chronic disorder. When acute, it is preceded by a constant sense of burning and itching, which the patient assigns to the chafing of the parts, and the continued itching of which usually continues to be one of the most annoying features of the disorder. A close examination will now show the edge of the fold of the buttock, as well as the margin of the anus, to be red, hot, moist, and abraded of cuticle, while at other points, minute vesicles, filled with serum, will be seen scattered around, as in the ordinary form of acute eczema of other parts. As the fluid escapes by the rupture of these vesicles, it may be either clear, like serum, or slightly yellowish in its tint, staining the linen of the patient, and forming on the skin around the anus, when it dries, the thin white or yellowish scales which are characteristic of eczema; or, if the affection is chronic, it will leave the parts of a dark-reddish color, with a slight crust on them, like that often noted on the legs, in connection with ulcers, and known as **Chronic Eczema Rubrum.** Not unfrequently this irritation is also found upon the thighs and scrotum of the male, and on the pudendum and perineum of the female, being often the result, in these cases, of the extension of the disorder from the anus.

Etiology.—Eczema of the anus may be developed by any cause that will induce congestion and superficial inflammation of the skin; thus, it is frequently the result and attendant of hemorrhoidal tumors, the capillary congestion created by the enlarged rectal veins, as well as the ichorous matter which flows from such tumors as are ulcerated, creating precisely the same condition of the skin about the anus that is seen on the legs, and has already been alluded to as one of the sequelæ of leg ulcers. Fissure of the anus, fistula in ano, prolapsus ani, etc. may also give rise to this disorder, though the irritation thus caused is not unfrequently regarded merely as a symptom of rectal disease, and treated accordingly, while it may be a distinct complaint.

Diagnosis.—The presence of one or more vesicles in the neighborhood of the anus, with the characteristic itching and burning of eczema as seen elsewhere, usually suffice to render the diagnosis easy, when the parts are carefully examined by placing the patient on his back before a good light, and then elevating and opening his thighs, so as to see clearly the entire perineum. When the examination is made from behind simply by opening the cheek of the buttocks, the folds of the skin, and the hair, found in the adult, often conceal the characteristic vesicles.

Patients.—Adults, both male and female, who are fleshy, constipated, and subject to hemorrhoids or fistula, are those mostly affected, though such as are thin and of the tuberculous diathesis also suffer from the complaint.

Prognosis.—The prognosis of eczema of the anus will depend upon the cause of the irritation. Usually, the patient can be readily relieved of the complaint when it is acute; but unless the hemorrhoidal congestion can also be removed, or when the disease is chronic, the prognosis as regards the cure should be guarded, the disorder being occasionally very difficult to remove, unless the functions of the rectum can also be restored to their normal condition.

Treatment.—When this external irritation of the anus is the result of constipation, or of a varicose condition of the hemorrhoidal veins, or of external piles, the administration of an active mercurial purge is always beneficial, the bowels being subsequently kept in a soluble condition by the administration of sulphur and magnesia, so as to correct acidity, after which the chief reliance must be placed on local remedies. These local applications should be regulated by the extent and character of the inflammation. If the eczema is acute, and accompanied by much burning and a free serous discharge, nothing will afford greater relief than frequent bathing with lead-water, or the application of pieces of lint wet with the same, the lint being retained by the use of a T-bandage; but when the disease is more chronic in its character, and presents a dry, scaly appearance, with intolerable itching, the warm water-dressing—that is, lint saturated with warm water, and covered by a piece of oiled silk—will prove most soothing; or the patient may steam the part by sitting over a vessel of hot water. Poultices of all kinds are objectionable, owing to their adhering to the hair, so that they become a source of irritation; while, if the latter is shaved off, the suffering of the patient will be increased in a day or two by the friction on the short ends as the hairs grow again. Much relief from the itching may also be obtained from the following ointment:—

℞.—Hydrarg. sulphuret. flavus, grs. xv;
Aconitiæ, grs. ij;
Pulv. camphoræ, grs. v;
Axungiæ, ℥j. M.
S. Anoint the parts thoroughly, and rub it well in with a soft rag.

The dry, scaly condition may also be benefited after steaming by anointing the part with the following ointment:—

℞.—Pulv. camphoræ,
Sodæ carb. āā grs. x;
Glycerin, ʒj;
Axungiæ, ℥j. M.

In the more chronic cases, especially if accompanied by a serous discharge, the following is often very useful:—

℞.—Hydrarg. chlorid. mit. ʒiss;
Pulv. plumbi acetat. grs. x;
Axungiæ, ℥j. M.
S. Anoint the parts twice daily.

Should external or internal hemorrhoids exist at the same time, these should be appropriately treated, though even then the means above directed will prove highly useful.

SECTION III.

DISORDERS OF THE RECTUM.

The **Disorders of the Rectum** requiring operative treatment are so numerous, and its structure so important, as to have engaged a large portion of the time of those surgeons who have devoted themselves specially to their study, and were they at present to receive the detailed consideration that might be expected, would occupy the remainder of my space. A condensed description must therefore suffice.

The aid of the surgeon may be required in this region for the removal of foreign bodies; for encysted rectum; fissure of the anus; imperforate anus; prolapsus ani; fistula in ano; hemorrhoids; stricture of the rectum; and extirpation of the lower portion of the bowel for cancer.

§ 1.—Removal of Foreign Bodies.

The **Removal of Foreign Substances** from the bowels may be accomplished by the finger, handle of a teaspoon, scoop, forceps, or other similar instrument, according to the circumstances of the case. In the removal of articles which have sharp points or cutting edges, it will be found advantageous to dilate the anus by means of a speculum ani, so as to protect the mucous coat, unless the size of the object should forbid it. In a case reported by Ruschenberger, of the U. S. Navy,* where a glass goblet, three and a half inches high, with a brim two and five-eighths inches, and a base one and seven-eighths inches, was introduced into the rectum of a Chinaman, the whole was removed by Parker, of Canton, by crushing it with strong forceps, protecting the parts with folds of cloth, and removing the smaller fragments with a teaspoon; and a similar treatment would be requisite for the removal of all fragile articles.

§ 2.—Encysted Rectum.

In 1792, Physick, of Philadelphia, called the attention of the profession to a condition of the rectum in patients who had been previously thought to labor under neuralgia of the anus, or a series of symptoms which some regarded as an imaginary complaint, and which had then been generally overlooked by surgical writers.† This condition is characterized by the following symptoms: "Sometimes the patient experiences little or no uneasiness between the stools; at others, he has a sensation of discomfort, as if a worm or insect were in the canal; or it produces an intense itching which is often sufficient to prevent sleep; and there is occasional pain after a stool, though this is uncomplicated with spasm of the sphincters. The touch shows no tumor or other disease of the gut; no pus is present, except when the disease is complicated; but an examination made by passing a hooked probe a short distance within the anus, and withdrawing it, will demonstrate the existence of a little pouch or cyst, which is so exquisitely sensitive to the point of the probe as to cause acute suffering."

These pouches were subsequently minutely examined by Horner, and their anatomical relations strictly defined,‡ so that now they are usually regarded as a normal portion of the gut, which only demands interference when it becomes the subject of diseased action. To relieve the symptoms above detailed, Physick proposed the excision of the affected cyst.

Operation of Physick, of Philadelphia.—Bend the point of a probe on itself for about half an inch, so as to form a hook, pass it into the anus, and by a movement backward and forward, and with the point close to the side of the gut, draw down the membranous portion or wall of the sac, and snip it off with the scissors, so as to lay the pouch completely open. As the irritation is liable to be reproduced, a repetition of the operation may be called for. Injections of cold water and attention to the fecal evacuation will subsequently facilitate the cure.

The necessity for this operation is now doubted by those who regard these pouches as the natural receptacle of the mucus, which, by lubricating the orifice of the rectum, facilitates the voiding of the feces.

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* Am. Encyclop. of Med. and Surg., article *Anus*, by Reynell Coates, M.D.

† Am. Journ. of Med. Sciences, vol. xvii. N. S. p. 410. 1849.

‡ Special Anat. and Histology, vol. ii. p. 147, ninth edition.

§ 3.—Fissure of the Anus.

Fissure of the Anus is the term employed to designate a long, narrow, linear ulceration of the verge of the anus, which sometimes extends from the sphincter ani to the folds of the skin on the margin of the anus, and is invariably attended by extreme pain on defecation, intense burning subsequently, and by spasm of the sphincter ani, a characteristic sign that has been much insisted on since the time of Boyer. When something more than a palliative treatment by anodynes, and similar means of producing relaxation of the sphincters is demanded, a cure may be accomplished by lightly cauterizing the surface, until the ulcer is healed, or by paralyzing the external sphincter by a transverse division of its fibres. This may be accomplished either by dividing the muscle from the inside of the gut outward, or by a subcutaneous incision, or by lacerating the ulcerated edges by dilating the anus, either by introducing the fingers or tents, or an anal speculum, as advised by Maisonneuve.

Operation of Dilatation.—The operation of dilatation is performed by introducing the index finger of each hand into the anus, and then forcibly dilating the contracted muscle first antero-posteriorly, and then transversely. The relief afforded by this simple means is sometimes almost instantaneous, and the operation is well worthy of trial before resorting to a division of the fibres of the muscle. But if it fail to cure, then the application of the knife may be practiced as follows:—

Operation of Boyer.—Place the patient on the side, introduce the left forefinger, well greased, into the gut, and pass a very narrow probe-pointed bistoury flatwise along the finger as a director. The cutting edge of the bistoury being then directed to the right or left side, according to the direction of the fissure, cut through the mucous membrane, and the fibres of the sphincter, dividing all the tissues at a single cut.* In the subcutaneous incision, the point of a very narrow, sharp-pointed bistoury is to be passed beneath the mucous coat near the fissure, and the fibres of the muscle divided by cutting outward. Then, turning the bistoury flatwise, withdraw it at the point of entrance.

Copeland, of England,† asserts that the incision of the mucous and areolar coat is sufficient, without dividing the fibres of the muscle.

§ 4.—Imperforate Anus.

The term **Imperforate Anus** designates those malformations in which the natural outlet of the rectum is closed either by a membrane, by a contraction of the anus, or by a congenital deficiency of the rectum, the gut terminating in a *cul-de-sac* at a distance which varies from a half inch to three inches. Its relief is to be accomplished by dividing the obstruction, as in the following plan:—

Operation.—Puncture the membrane or the integument at the proper point, for the anus, either with a trocar, abscess lancet, or bistoury, and dilate the opening by means of a tent. Should contraction of the orifice supervene, as is frequently the case, make a crucial incision in the part, or dissect out a portion of the integuments.

Although the operation for imperforate anus is one which does not present

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* American Encyclop. of Med. and Surg., loc. cit.

† Lond. Med. Gazette, vol. xvi.

PLATE LXIII.

OPERATIONS PRACTICED ON THE RECTUM.

Fig. 1. Removal of hemorrhoids by means of the ligature. On the right side is seen the double canula and wire ligature of Physick, and on the left the application of the double silk ligature. 1, 2. Two ends of the ligature passed through the piles, and intended to strangulate one-half of the tumor. 3, 4. The other ends of the ligature about to surround the opposite half. 5. The wire ligature as applied. *After Nature.*

Fig. 2. Horner's Operation for the removal of hemorrhoids. The patient being placed on the side to be operated on, the hand of one assistant draws up the buttock of the opposite side. A ligature being then passed through the largest pile and tied in a loop, the thread is held by another assistant, or by the surgeon. A short tenaculum transfixing the base of the pile now draws the tumor off from the buttock, while the surgeon makes an incision around the external side of its base, so as to free it from its connection with the skin. The loop of a wire ligature being then thrown around the pile, so that one side of the loop lies in the incision, while the other is applied on the mucous surface of the tumor, the latter is perfectly strangulated without the integuments being involved in the ligature. 1, 2. Hands of assistant. 3. Ligature passed through the tumor to prevent its retraction within the rectum. 4. Tenaculum raising it from the side of the anus. 5. Double canula and wire ligature. *After Nature.*

Fig. 3. Operation for Imperforate Anus, and extirpation of a small flap. 1. Forceps. 2. Scissors. *After Bernard and Huette.*

Fig. 4. Dupuytren's Operation for Prolapsus Ani. 1. Forceps. 2. Scissors excising a fold of the skin at the verge of the anus.
After Bernard and Huette.

Fig. 5. Ricord's Operation for Prolapsus Ani. 1, 2. Ligatures passed through the mucous coat so as to elevate the portion to be excised. 3. Curved scissors.
After Bernard and Huette.

[illegible]

Fig. 1

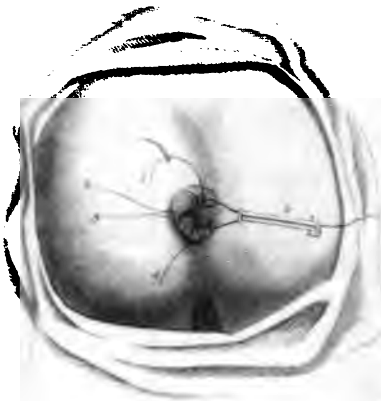


Fig.

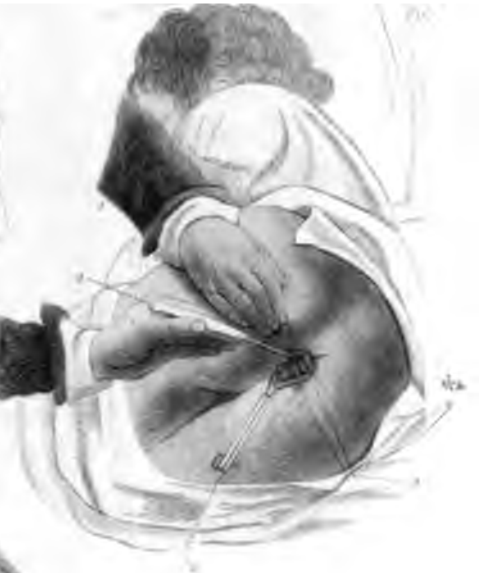


Fig. 3.

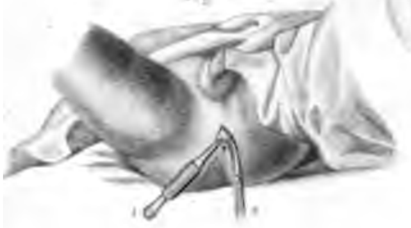


Fig. 4.

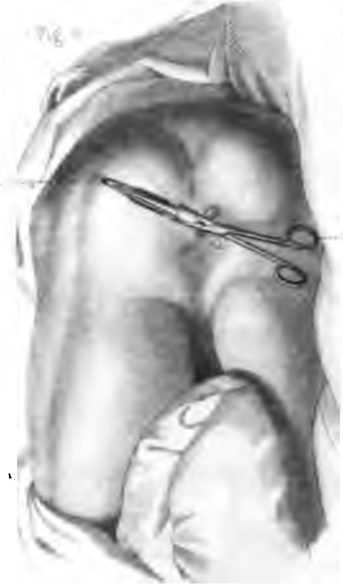
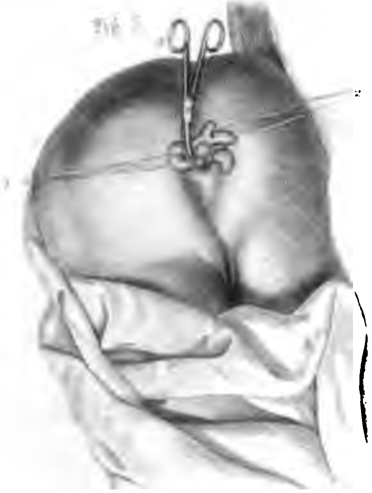


Fig. 5.



any very great difficulties in its performance, it is as well that the surgeon should be reminded that there is no immediate haste necessary in performing it, and that its execution will be easier in proportion as the delay gives time for the accumulation of feces in the rectum so as to cause a protrusion of the end of the bowel and the formation of a tumor. In one case, reported in the *Provincial Medical and Surgical Journal*, (March, 1851,) a child with imperforate anus lived for 102 days without any evacuation, and during this time never vomited; and though such an instance is a rare one, it yet suffices as a nexample of the tolerance of infants under these circumstances.

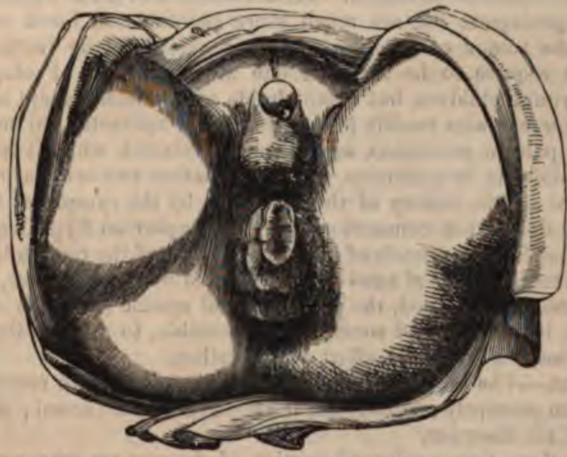
In four cases which have come under my observation, I have operated at periods which varied from forty-eight hours to five days, and lost only one patient. Three of them were males, and one a female.

§ 5.—Prolapsus Ani.

As the mucous coat of the rectum is very movable upon its muscular coat through the intervention of the areolar coat, it facilitates the escape of the feces from the anus by protruding slightly over the edge of the sphincter ani muscle, as is well seen, though in a greater degree than in man, in the defecation of the horse. When thus protruded, the action of the levator ani muscle again draws it within the sphincter, which, closing firmly, retains it within its folds.

But when the sphincter ani becomes very much relaxed, or the levator ani loses its power, or the connective tissue becomes infiltrated with serum, the protrusion of the mucous coat becomes more marked and permanent, or the bowel itself becomes invaginated and forms a tumor at the anus, which is known as **prolapsus ani**, or as "falling of the body," or sometimes is spoken of as "the body coming down."

Fig. 438.



A front view of the Appearance of the Parts in Prolapsus Ani, showing the Circular and Concentric character of the Folds of the protruded Mucous Coat.

Etiology.—The causes creating this condition in adults may be either those that tend to relax and weaken the attachments of the rectal mucous membrane, or such irritation as creates straining, and forces the bowel outward, or it may be due to the extension of irritation from the bladder or adjacent parts—or to inflammation, as after the tenesmus of dysentery. The various causes in children may be constant crying, long straining at stool, obstinate diarrhœa, dysentery, and stone in the bladder; while in the adult it also often ensues on constipation, on hemorrhoids, on the use of aloetic purges, or on the constant use of purgative enemata; the relaxation of the anus is also created in men by the free use of tobacco.

Symptoms.—After an effort at stool, a tumor is found at the anus, which is soft, pinkish, corrugated, and evidently covered by a mucous membrane which shows evidences of congestion if firmly constricted by the sphincter ani muscle, becoming darker and more purplish in its color, and inflamed, hot, and painful, if not soon replaced. When of long standing, the prolapsed portion becomes hard, firm, and resisting from the effusion of lymph into the submucous areolar tissue, which renders it difficult to replace the part; but when recent, the tumor will often disappear within the rectum by its own contraction, or may be readily replaced by the gentle pressure of the fingers. When a chronic, thickened and constricted tumor becomes more or less permanent in its position, and is congested, indurated, and difficult to reduce, and is also violently constricted at the anus, it may inflame, suppurate, ulcerate, or slough off, as is sometimes seen in the chronic tumors of old people in almshouses and hospitals where the prolapsus has been long neglected.

Patients.—Prolapsus ani is met with at both extremes of life, being often seen in children under three years, and also frequently developed in adults over sixty years of age.

Diagnosis.—Prolapsus ani may be told from hemorrhoids or piles by the fact that the tumor in prolapsus is usually a mass formed of continuous and concentric circular folds around the anus, and presents a villous-like surface, while hemorrhoids are more or less distinct tumors, resembling in size and color the intestine of a chicken if distended with indigo water and tied every half inch or two inches in length. Hemorrhoids also do not create as bulky a tumor as prolapsus ani, are much more painful, and bleed more freely, and while the tumor of prolapsus is returnable into the rectum in mass, hemorrhoids require to be replaced one after another. Prolapsus ani is common in young children, but hemorrhoids are not seen except in the adult. The forefinger will also readily pass through the sphincter ani muscle without causing pain in prolapsus, as the anus is relaxed, while it is contracted and quite painful in hemorrhoids. Condylomatous tumors can be told from prolapsus ani by the history of the case, and by the symptoms which have been already detailed in connection with the chapter on **Syphilis.**

Prognosis.—The prognosis of a recent prolapse of the rectum is favorable, but in the chronic tumors of aged adults it should be guarded; for, though the protrusion may be returned, the sphincter ani muscle is usually so much relaxed that it is difficult, and sometimes impossible, to prevent the reproduction of the tumor at the next effort at defecation.

Treatment.—The indications in the treatment are: 1, to reduce the prolapsed rectum promptly; 2, to retain it within the sphincter ani; 3, to remove the cause of the disorder.

The reduction of the prolapsed portion of the rectum may usually be accomplished by placing the patient in the horizontal position, and anointing the entire tumor, as well as the fore or the first two fingers of the surgeon's hand with olive oil or lard; then, pressing upon the centre of the tumor, carry a fold of it up into the rectum within the sphincter ani muscle with the fingers of one hand, and pushing up another fold with the other fingers, retain the first until the second is nearly within the sphincter, continuing the manipulation till the entire tumor is restored, when a piece of spread cerate should be placed over the anus, and held there for a few hours by a compress and T-bandage. The prolapsus of children does not usually demand so much manipulation, and, when once returned, does not require the employment of a compress, as it will remain reduced until the next effort at defecation. Much may be done, both in adults and children, to prevent the recurrence of prolapsus by requiring them in defecating to sit on a seat which is inclined at an angle of 45° to the horizon, so as to throw the weight of the intestines upon the abdominal parietes, and prevent the action of the muscles from compressing the rectum in a perpendicular line. The seat upon which they sit in defecating should also have a very small and narrow opening, not more than four or six inches wide for an adult, so as to support the cheek of the buttock, and thus aid in the lateral compression of the anus at the moment of defecation. If the prolapsus is due to constipation, laxatives should be constantly employed, while if it is due to the tenesmus of dysentery, injections of laudanum will prove useful, ascarides and worms in the bowels being removed by an appropriate treatment. The retention of the bowel after its reduction may generally be accomplished simply by the use of a compress, or a pad attached to a vertical spring, which is fastened to a band around the pelvis, such an instrument being made by the cutlers, for the bad cases occasionally met with in old people. Sometimes it may become necessary to employ, for a few days, a rectal pessary, so as to give the mucous membrane an artificial support, especially if the sphincter ani is much relaxed. Should the tumor be very much congested and inflamed, it will be best to keep it constantly bathed with cold water for a few hours previous to attempting its reduction, or it may even require the local abstraction of blood by leeches around the base of the tumor.

In some cases benefit will be derived from injections of the infusion of rhatany, or weak solutions of the tinctura ferri chloridi, in the proportion of twenty drops or half a drachm to the ounce of water, the strength being regulated by its stimulation, which should never be sufficient to cause pain. The decoction of white oak bark, or an ointment of ten grains of tannic acid to the half ounce of lard, a portion of which is to be placed within the anus, is also often highly serviceable.

When the sphincter ani and the verge of the anus are very much relaxed, an operation may be demanded, while the tumor may require the removal of a strip of the mucous membrane, or the application of caustic, or a ligature, for its radical cure in the chronic prolapsus of adults.

Operation of Dupuytren.—With the patient in the position just recommended for the restoration of the bowel, pick up with a pair of forceps one of the radiated folds of the skin on the verge of the anus, and cut it off by means of scissors curved on the sides, prolonging the cut about one-fourth of an inch into the mucous coat of the gut.

After this one, two or more similar folds may be excised, and the wounds left to cicatrize.

Velpeau,* instead of this, prefers union by the second intention, and after excising a fold, introduces a little lint into each wound, in order to insure suppuration and favor the subsequent contraction of the cicatrix. The cure, in either plan, being dependent on the contraction of the parts thus induced, the surgeon should be cautious in regard to the amount excised, lest he produce such a diminution of the anus as will interfere with the subsequent efforts at defecation.

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* Mott's Operat. Surgery, vol. iii. p. 1106.

Operation of Robert.—Excision of a Portion of the Sphincter Ani.—Remove, either by scissors or the scalpel, a transverse portion of the sphincter ani muscle, and unite the wound by a twisted suture.

Operation of Cheselden.—Cauterization.—Apply caustic potash lengthwise upon one or more points of the mucous coat, favor the suppuration, and await the cicatrization. The French surgeons sometimes prefer the actual cautery, or strong nitric acid similarly applied.

Excision or Amputation of the Tumor.—In very bad irreducible cases, the adhesions of the adjacent portions of the tumor prevent its reduction; suppuration and sometimes hemorrhage ensue, and the aged patient is exhausted by the discharge and suffering. Under these circumstances, the removal of the tumor by excision or ligature has been practiced, and may possibly, though rarely, be again demanded.

Operation of Ricord.—Pass a needle and ligature through the mucous coat alone, near the base of the tumor, so as to retain it in position, and excise it by a circular cut either with the scissors or bistoury, arresting the hemorrhage by ligating each vessel as cut. Then removing the retaining ligature, guard against secondary hemorrhage, and obviate excessive contraction by the use of bougies.

Remarks.—In the operations just quoted, little difficulty will be found in their performance, but much judgment will be requisite in deciding upon their necessity. In young patients such operations will seldom be required, as these cases usually yield to the treatment before described without any other operation. If the prolapsus is so marked and obstinate as to require the adoption of an operation, that of Cheselden should be first tried, and then, if requisite, resort may be had to the operation of Dupuytren. In excising the folds as there directed, four generally suffice, one being in front, another behind, and two others laterally, as directed by him; the amount included in the forceps, and excised, being regulated by the degree of relaxation of the anus.

§ 6.—Hemorrhoids, or Piles.

Pathology.—Hemorrhoids—*αιμα*, blood, and *ρεω*, to flow—consist of tumors seated at or near the verge of the anus, which, when ulcerated, are liable to bleed at each effort at defecation. Although this complaint has been long known to the profession, there is yet a diversity of sentiment in regard to its pathology. By some writers, hemorrhoids are described as a varicose condition of the anal veins, (Jobert;) or as tumors resulting from a laceration of the veins and the effusion of blood into the adjacent submucous or subcutaneous areolar tissue, (Ribes;) or as preternatural cysts, which are sometimes distended with blood and very much swollen, while at others they are more empty and flaccid. These different views, as thus expressed by distinguished surgeons, can only be reconciled on the supposition that a condition of parts similar to each of those described may accompany every case of hemorrhoids at some period of its course. On this supposition, and with a knowledge of the minute anatomy of the anus and rectum, it appears an easy matter to harmonize these varied conditions, and explain the true pathology of the complaint. Thus the mucous membrane, at the verge of the anus, being continuous with the skin, and having beneath it a fine anastomosis of veins without valves, which veins are seated in a connective tissue, and directly continuous with those of the mesentery, may be ruptured and create precisely such a condition of parts as has been described by Ribes; while in the distended condition we may yet refer the whole complaint to a varicose condition of the veins of the anus, and especially of the hemorrhoidal plexus, as stated by Jobert. Thus constipation, straining, and all the usual causes of hemorrhoids may first induce fullness of these vessels, then serous or lymphy infiltration of the connective tissue in which the distended veins freely anastomose, while their rupture will readily lead to effusion of blood, and the formation of a cyst covered by mucous membrane or skin, according as the vessel is above or on the line of the external sphincter ani. If, then, absorption of the more liquid parts of such a cyst were to ensue, it would certainly create a semi-solid or mulberry-like tumor, such as is described by Ribes, while the inflammation and ulceration of either the mucous or cutaneous surface of the tumor might give rise to a hemorrhage the amount of which would depend on the size of the vein opening into it. If, then, it is wished to define the pathological characters of an external pile, I should say it is a tumor covered by the skin or mucous membrane on the verge of the anus, which tumor is due either to a laceration of the hemorrhoidal veins, and the escape of blood into the subcutaneous connective tissue, or to a varicose condition of the vessels. The first tumor, when excised, will not bleed, but simply give vent to a clot, or perhaps present the appearance of the semi-erectile tissue, before referred to. In connection with the varicose condition of the veins, we may also find such an enlargement of the arterial capillaries as is usually due to inflammatory action under any circumstances.

An internal blind pile being, on the contrary, a varicose enlargement of one or more branches of the same veins higher up the rectum, will consequently be a tumor covered by the mucous coat of the part, which mucous covering is liable to become elongated by infiltration of its submucous connective tissue; while if it inflames, ulcerates, and opens a vessel, it would give rise to a hemorrhage that would be most marked when the efforts at defecation create congestion. Such a tumor will, therefore, require to be treated with an especial regard to this inflammation, as well as with reference to the hemorrhage likely to follow the opening of veins without valves, or of small arteries so situated as not to be readily seen.

Etiology.—The local causes of hemorrhoids may be anything that will create engorgement and distention of the hemorrhoidal veins, as straining from constipation, pregnancy, constant sitting on warm cushions, or the excessive use of tobacco, which, relaxing the anal muscles, favors congestion of the part, in a plethoric habit; or the congestion created by irregular menstruation may act as a predisposing cause.

Patients.—Hemorrhoids are seldom if ever seen in those younger than eighteen years of age, being generally met with in the prime of life, though they are not unfrequently found in those as old as sixty-five years. They may attack either sex, and especially those who lead sedentary lives, or are dyspeptic.

Symptoms.—As hemorrhoidal tumors are due to vascular changes in the rectum, which induce inflammatory and neuralgic irritation, the earliest symptom of their presence is a sense of fullness and irritation, or soreness about the anus, which is especially marked for an hour or more after an evacuation. Soon these symptoms become more distinct, creating the sensation of a foreign body being in the rectum, and giving rise to a feeling of dissatisfaction, or a repeated desire to stool, the pain extending toward the sacrum and spine, or toward the bladder and down the thighs, from the nervous connections of the part. The feces are now sometimes streaked with blood, or the paper is tinted, or about a teaspoonful of blood escapes toward the end of the stool; itching is also developed near the anus, this being often due to eczema, while the parts are constantly moist, and the linen soiled with pus or blood. The escape of blood usually gives temporary relief, but, if often repeated, creates evidences of anæmia. At the next stool the tumors may be more engorged, and the patient will recognize their presence with the finger. If they continue to be constricted by the sphincter ani, or any irritation increases the afflux of blood to them, they will then be more tumid, hot, and painful, and, if now inspected, will be found to be violet colored, smooth, shining, and exquisitely painful to the touch. As the irritation continues, the sphincter ani participates in it, and contracts spasmodically, causing the patient to scream violently with the shooting character of the pain, while defecation creates horrible torture, the tumor then becoming much blacker and larger, and terminating sometimes—if left unreduced—in ulceration of the part after a day or two. Sometimes, on the contrary, the spasm passes off, and the tumor is then less engorged, until, after forty-eight hours, it is quite flaccid, and the patient may be comparatively comfortable, or only suffer at the periods of defecation. The constricted condition, with the irritation and intense suffering just described, is usually said to be due to *a fit of the piles.* The long continuance of hemorrhoids usually causes great disorder of the digestive, circulatory, and nervous functions, the patient being liable to dyspepsia, flatulence, colic, and a sense of constriction, or sinking about the umbilicus, while he is troubled with palpitation of the heart, a quick, irritable pulse, dyspnœa, and the other symptoms of anæmia. Not unfrequently his entire moral character is changed, becoming cross, peevish, irritable, and irascible, quarreling with every one, and not unfrequently resorting to the use of alcoholic drinks or opium to deaden his sensibilities.

Diagnosis.—The knotted character of the tumors; their position on the side, and not in the centre of the anus; their violet color; their bleeding, etc., generally render the diagnosis of hemorrhoids easy.

Prognosis.—The prognosis of this disorder is decidedly favorable, unless complicated with bad prolapsus ani, in an old and broken-down patient, when it should be guarded; but I regard every case of hemorrhoids, not thus complicated, as susceptible of being cured, with safety to the patient, if carefully operated on.

Treatment.—The treatment of hemorrhoids may be either palliative or radical. The palliative consists in administering, every day, before the patient goes to stool, an injection of a full pint of cold flaxseed mucilage, or of cold water, though the first is preferable. Then the parts, after defecation, should be well bathed in cold water, the bowels kept free by mild purgatives, and some of the balsams or terebinthinates be occasionally administered. The following is a remedy which will often prove serviceable, especially when the tumors are ulcerated, and bleed, as it acts directly on the mucous membrane:—

℞.—Pulv. resinæ, ʒj;
Bals copaibæ, f℥ss;
Mel despumat. ℥ivss. M.

S. A tea or dessert-spoonful at bedtime, each night, till the bowels become free and the irritation is relieved.

Comfort will also be obtained from the use of anodyne and astringent ointments.

℞.—Pulv. acidi tannici, grs. x;
Pulv. plumbi acetat. grs. v;
Ext. aconitum nap. ʒss;
Axungiæ, ℥ss. M.
S. Anoint the part thoroughly.

When the tumors are external, attention should also be given to the existence of eczema of the anus, which should be treated as before directed.

Radical Treatment of Hemorrhoids.—The radical treatment of hemorrhoids consists in destroying the tumors in patches, by the use of nitric acid or other caustics, and in their entire removal by the wire ligature, or by the écraseur. In the ancient method of treating hemorrhoidal tumors, when they were removed by excision, frightful hemorrhages sometimes supervened; the accounts of which have created so much alarm in the minds of patients that many continue to suffer for years from hemorrhoids, rather than—as they suppose they must—risk their lives by an operation. It becomes, therefore, the duty of every medical man to disabuse them on this point, and to assure them that, by the operations now performed, they can not only be safely relieved, but radically cured. Out of more than eighty patients that have been operated on, to my knowledge—many of whom have been in my own practice—but one has died from Horner's operation, as hereafter described; while in but one has it been necessary to operate on the second side, after the tumor had been removed by a previous operation on the other.

I. Application of Nitric Acid.—Strong nitric acid, when applied for the relief of hemorrhoids, as suggested* by Houston, of Dublin, in 1843, and also by Cusack, is especially applicable to those cases in which there is hemorrhage, with marked ulceration and thickening of the mucous coat over the pile. It proves useful by its caustic effects inducing sloughing and subsequently the cicatrization of the ulcer. It also changes the action of a chronic swelling, or induration of tissue, so as to cause the effused lymph to serve the purposes of healthy organization, instead of creating a diseased enlargement in the connective tissue around the veins.

In applying it, the piles may either be protruded, or else the rectum be dilated by means of a glass speculum with an opening in its side, the opening being turned to the tumor. Then, with a piece of soft wood or a hair pencil dipped in a little of the strong acid, touch the tumors in a longitudinal direction, so as to destroy entirely the vitality of the part touched, without permitting the acid to spread to the adjacent parts. In order to do this, but a few drops of the acid should be put on the brush or swab, and the adjacent parts being painted with sweet oil, the cauterized portion should be washed with the same immediately after the application of the acid.

The advantages claimed for this treatment, by Houston, are safety from hemorrhage, and contraction of the vessels and tissues consequent on the separation of the slough. The objection to its use is the continuance of severe pain, when the cauterization is not sufficient to *kill* the part, or when any portion of the acid escapes on to the skin, at the verge of the anus.

Thweatt, of Virginia, has successfully treated hemorrhoids by this means, and so have several other surgeons in the United States. Cooke, of England, has also related† six cases of hemorrhoids cured under the use of the nitric acid, by applying a dossil of lint dipped in the acid to the pile, and pressing it there for fifteen or twenty minutes; during this time the pain is severe, though the cure is rapid; an abscess close to the sphincter muscle also followed in one case, but ultimately got well. Severe dysuria has frequently supervened, and the ulcer left by the separation of the slough requires after-treatment on general principles.

II. The Ligature.—The hemorrhoidal tumor may be strangulated either by threads passed through its base, and then tied so as to surround it, or by encircling it with a wire ligature drawn tight by means of a double canula, (Physick,) or by throwing a simple loop of silk over it, so as to constrict its base, Plate LXIII. Fig. 1.

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* Dublin Med. Journ., March, 1843, p. 94, et seq.; also Sept. 1844.

† London Med. Times and Gazette, April, 1853.

These methods of applying the ligature are often followed by serious symptoms, and its employment is better effected by the plan of Horner, hereafter described.

III. **Excision.**—The removal of hemorrhoidal tumors by excision may be effected by seizing them in toothed forceps, and removing them with scissors curved on the side, (Dupuytren,) or by passing a ligature through the tumor, and excising it with a bistoury.

As illustrative of the dangers sometimes created by excision, I cite the following unpublished case left in manuscript by the late W. E. Horner, of Philadelphia:—

Excision of Hemorrhoids, free hemorrhage.—"The Hon. Mr. B., member of Congress from Ohio, has had hemorrhoids for several years. He has lost but little blood from them. By forcing he brings down three of a purple color, and about half the size of an ordinary fig.

"He appears to be about forty-five years of age, short, but muscular and powerful, and of great energy of character.

"Operated on by T. Harris as follows: the tumors being forced down, a ligature in the case of each one was passed longitudinally through its base with a needle. This ligature being then drawn up slightly, the tumor was excised at its base with a pair of strong scissors. A flat fold of the skin, at the margin of the anus, was also excised.

"Operation done at 11½ A.M., and borne with remarkable fortitude. At a quarter past twelve profuse bleeding and alarming faintness having come on, lint dipped in creosote was introduced into rectum. This not answering, about ʒij of creosote mixed into a ball with wheat flour was introduced by means of a speculum. But little blood was discharged externally, but, from the extreme prostration, attended with faintness and vomiting, urgent thirst and general uneasiness, apprehensions were excited that an internal bleeding might be taking place in the colon.

"About 3½ P.M. faintness still alarming, with some slight external flow of blood; on introducing a speculum, the suppository of flour and creosote came away. The rectum was then packed with lint imbued with the creosote.

"About 8½ P.M. discharged the lint, and with it about a pound of coagulated blood.

"His condition being the same up to 10½ P.M., a teaspoonful of laudanum was given by the mouth.

"He took, in the afternoon, some doses of the acetate of lead, but his stomach was too irritable to retain it.

"In the morning some brandy and water was given; also neutral mixture.

"There was no very active external hemorrhage after the first day, but the extreme pallidness of his face and the prostration indicated that it had occurred, to a large extent, into the colon.

"In five or six days afterward, his bowels being opened by an injection, an immense quantity of dark grumous blood came off, showing that great internal hemorrhage had occurred while he was in the fainting condition.

"In about four weeks he left the city, cured."

IV. **Incision at the Base of the Pile, followed by Ligature.**—The objection to the use of the wire ligature, as usually applied, is the extreme pain induced by the constriction of the nerves of the skin, as well as the suffering and delay consequent upon the sloughing of the tumor. The following plan has, therefore, been suggested, in order to obviate suffering, and effect a speedy, safe, and permanent cure:—

Operation of Horner, of Philadelphia.*—Calm the irritability of the rectum by cold water injections, employing them several days before the operation. Then, at the time of the operation, empty the rectum, direct the patient to force out the tumors by straining in a squatting position over a vessel of hot water, and place him in bed on the side corresponding to the tumors after they are protruded.

Now, after a thorough etherization, pass a large needle and strong silk ligature transversely through the upper part of the largest tumor, and, removing the needle, form a loop by tying together the ends of the ligature, directing it to be held by an assistant, so as to prevent the retraction of the hemorrhoids within the rectum, Plate LXIII. Fig. 2. A strong awl, or slightly curved tenaculum, being next made to transfix the base of the same tumor in a line transverse to the ligature, the assistant should hold this with his other hand so as to pry or elevate the mucous coat from the subjacent parts, when the surgeon should make a semicircular incision around the base of the tumor of a sufficient depth to detach the anal plexus of veins from the sphincter muscle, cutting into the skin and not upon the mucous lining of the bowel, keeping sufficiently close to the margin of the anus to prevent a fold of integument being left upon its edge, as this is apt to swell, inflame, and become exceedingly painful. The awl and ligature being then passed through the loop of a wire ligature, the latter should be carried around the base of the tumor, so as to occupy the line of the incision on one side, and the mucous covering of the tumor on the other. The wire being drawn perfectly tight, or until the tumor becomes dark brown or black, its end should be fastened upon the canula, and the venous plexus will be perfectly constricted through the mucous coat of the rectum on the inner face of the tumor, and through the connective tissue of the gut on its outer side. If the tumor remains large and very tumid, after being constricted by the ligature, puncture it with a lancet or bistoury, and permit its blood to escape; after which a piece of cerate should be temporarily placed between the tumor and the incision in the skin of the margin of the anus, to guard against adhesions of the tumor, and an anodyne enema given, the thread ligature being left in the hemorrhoid for four and twenty hours, when it may be used to elevate the tumor while it is snipped off with a pair of scissors, the wire loop being thus freed from its position without creating any loss of blood.

The **Ecraseur.**—The suggestion, in 1855, by Chassaignac, of Paris, of a means of slowly strangulating any tumor until the ligature cut or lacerated through the mass by means of a chain drawn tight in a shaft by a screw—the instrument being called the **Ecraseur**, or crusher—has attracted considerable attention, and was received at first with marked favor. A calmer investigation, aided by experience, has, however, tended to excite in the minds of many great doubts of its utility, while its application by the author to the removal of mammary glands, legs, etc. has created the distrust often caused by blind enthusiasm. To hemorrhoids it was, however, supposed that the écraseur would be specially applicable, and well adapted for their removal without risk of hemorrhage or other evil result. Experience, even as stated by Chassaignac in his treatise on "l'Ecrasement Lineaire," has, however, shown that hemorrhage does occasionally supervene, that contraction of the anus is sometimes so marked as to render it desirable promptly to open the wound left by the écraseur, and introduce a meche; while, in some instances,* the belly has become enormously distended by flatus, owing to the adhesions of the side of the anus, the dilatation of which exposed to hemorrhage, and necessitated the use of the meche to prevent the growing together of the adjacent portions of the orifice of the bowel.

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* Am. Journ. of Med. Sciences, vol. iv. N. S. p. 358.

Although as a matter of history, and to enable others to judge for themselves of the advantages of this so-called new operation, I cite it, it is with no wish to recommend or approve of its repetition. With the safety and benefits of ligation by the use of threads, or by the application of a wire ligature or the sloughing of the tumors by nitric acid, well established, there is no good reason for substituting a plan that requires a resort to an expensive instrument as an addition to strangulation by a ligature previously applied to pediculate the mass; it being well established that the écraseur cannot be made to act on tumors with broad bases. Chassaignac's operation is as follows:—

Fig. 439.

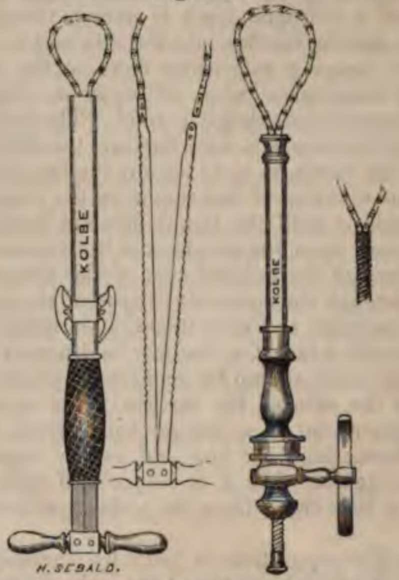

Fig. 439.—Two varieties of the Ecraseur of Chassaignac, showing how the loop of the chain is tightened so as to excise by slow pressure whatever is included in its grasp. (After Kolbè.)

Operation of Chassaignac by the Ecraseur.—In order to form a pedicle for the tumor, the forefinger of the operator, with a large loop of a ligature on the knuckle, should be introduced into the rectum, with the last phalanx curved so as to hook out toward the exterior of the anus the hemorrhoidal tumor, without bringing it entirely out of the gut. The loop of this ligature, being then pushed by an assistant over the convex side of the forefinger as far as possible to the base of the pile, is then to be drawn tight (Fig. 440) around the tumors.

The loop of an Écraseur being now made to surround the hemorrhoids close above the ligature, is to be slowly tightened, about one link of the chain being drawn within the shaft every half minute, so as to give time for the formation of a coagulum in the veins of the hemorrhoids; the excision by the écraseur occupying from twelve to fifteen minutes.*

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* Op. cit., pp. 89 and 102.

Fig. 440.

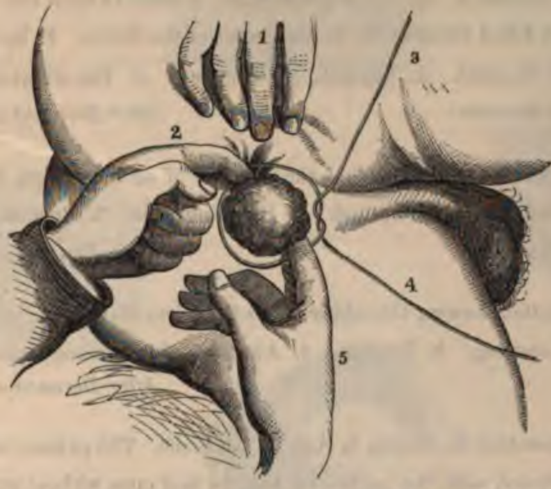

Fig. 440.—A view of the Preliminary Steps necessary in the removal of Hemorrhoids by the Ecraseur. 1. The hand of an assistant supporting the buttocks as the patient lies on his right side with the left thigh strongly flexed on the pelvis. 2. The left forefinger. 5. The right forefinger of the operator in the act of passing the loop of a ligature, 3, 4, around the hemorrhoids, in order to pediculate the tumor for the écraseur. (After Chassaignac.)

Fig. 441.

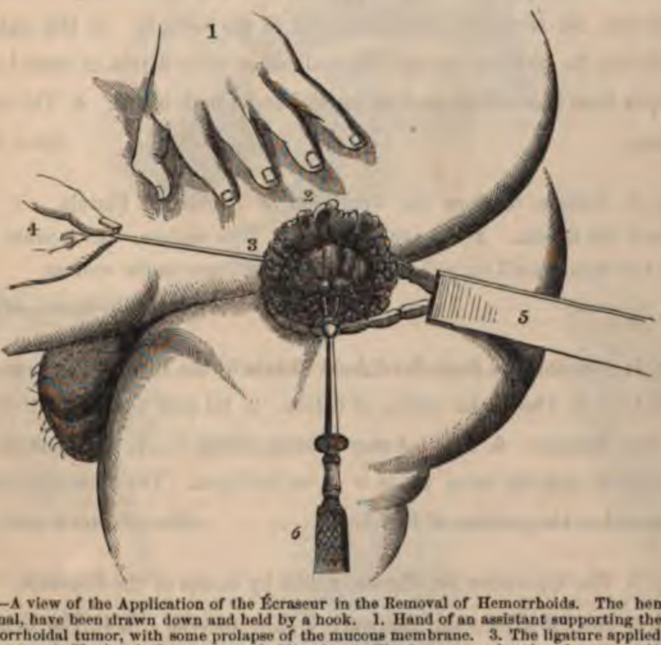

Fig. 441.—A view of the Application of the Écraseur in the Removal of Hemorrhoids. The hemorrhoids being internal, have been drawn down and held by a hook. 1. Hand of an assistant supporting the buttock. 2. The hemorrhoidal tumor, with some prolapse of the mucous membrane. 3. The ligature applied to pediculate the tumor. 4. The hand of an assistant holding it. 5. The écraseur embracing the tumors in its loop. 6. The multiplied hook. (After Chassaignac.)

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* Traitement par l'Ecrasement Lineaire, par M. E. Chassaignac, p. 64. Paris, 1856.

PLATE LXIV.

OPERATIONS FOR FISTULA IN ANO.

Fig. 1. A Section of the Rectum and Anus, in order to show the relations of the parts in a Blind Fistula. 1. Rectal orifice of the fistula. 2. Its position in the fat about the anus. 3. The gut. 4. The anus. 5. The structure immediately around the anus. *After Bernard and Huette.*

Fig. 2. A similar section to show the relations of an Incomplete Fistula. 1. Orifice of the fistula in the buttock. 2. Its termination. 3. Rectum. 4. Anus. 5. Surrounding parts. *After Bernard and Huette.*

Fig. 3. Section showing the relations of a Complete Fistula. 1. Rectal orifice. 2. External opening. 3. Rectum. 4. Anus. 5. Surrounding structures. *After Bernard and Huette.*

Fig. 4. Operation for Fistula in Ano by the Knife. The patient being placed upon the affected side, the parts can thus be laid open without exposing the surgeon to the chance of injuring his own finger, as has often happened by the sudden motion of the patient when placed upon his hands and knees. 1. The hand of an assistant supporting the buttock. 2. The left forefinger of the surgeon passed into the rectum to touch the point of the bistoury. 3. His right hand introducing the bistoury through the anal orifice of the fistula, in order to divide the parts from above downward as he withdraws both hands. 4. The fistulous opening. *After Nature.*

Fig. 5. Section to show the Operation of Probing a Fistula. 1. Rectal orifice of the fistula. 2. Its anal orifice. 3. The rectum. 4. A probe passed along the fistula until its point touches the forefinger in the rectum. *After Bernard and Huette.*

Fig. 6. Division of a Superficial Anal Fistula by the Bistoury, as passed along a Director. 1. The rectal orifice of fistula. 2. Its anal opening. 3. The gut. 4, 5. The director. 6. The bistoury passing along it. 7. The portion of the integuments near the anus, which is to be laid open. The drawing represents the patient in the position of Fig. 4. *After Bernard and Huette.*

Fig. 7. The Operation for Fistula in Ano by means of the Ligature. 1. The rectal orifice. 2. The anal opening. 3. The rectum. 4, 4. The ligature *in situ*. 5. The tissue to be divided. *After Bernard and Huette.*

Plate 64.

Fig. 1

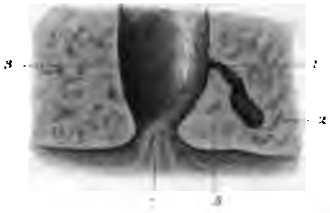


Fig. 3

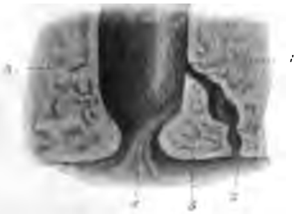


Fig. 2.

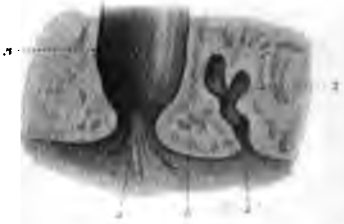


Fig. 4.

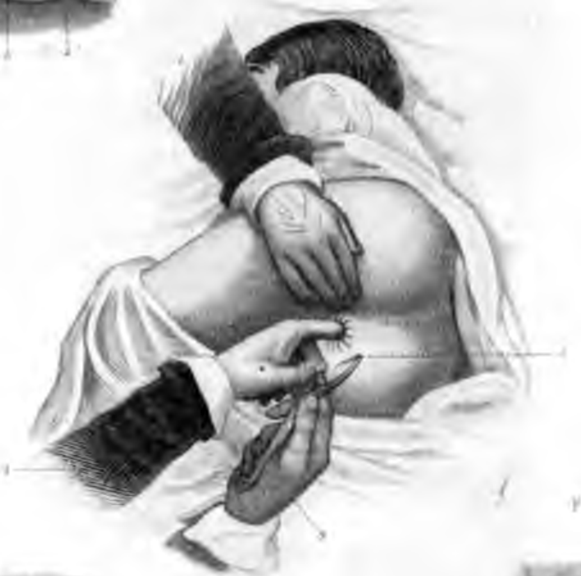


Fig. 5.

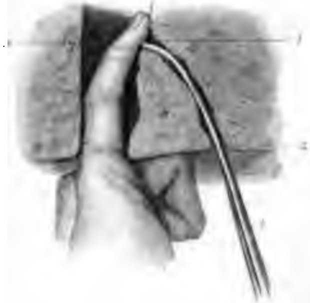


Fig. 6.

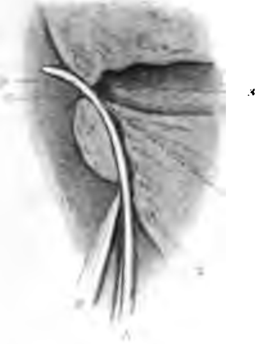
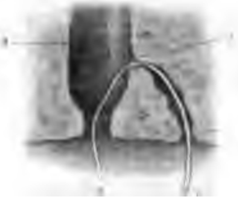


Fig. 7.



Remarks.—The dangers that have been incurred in the excision of piles, and the suffering consequent on the ordinary method of applying the ligature, are facts that every experienced surgeon must have frequently noted. When, therefore, it is necessary to select a mode of operating, I would recommend that proposed by Horner, as it is one the success of which I have well tested. In but one case has it been necessary to repeat the operation, while many, and some even of the very worst hemorrhoids that I have ever encountered, have been cured in about two weeks, some patients being able to sit up in bed in seven days; and daily experience only tends to increase my confidence in it. It is, however, of great consequence that the tumor should not be excised and the ligature removed until the strangulation has entirely interrupted the circulation of the part, lest hemorrhage be induced subsequently. In one patient, within the last two years, free hemorrhage supervened several hours after the removal of the ligature, in consequence of the vomiting induced by the use of the anæsthetic. Though arrested by ligating the vessels, severe diarrhœa followed, and the patient died on the fourth day.

§ 7.—Fistula in Ano.

Pathology.—When, from any cause, an abscess is developed about the anus, it may discharge itself by one or more small orifices, either externally upon the buttocks, internally into the gut, or by both surfaces. From the constant action of the sphincter and levator ani muscles, the approximation of the sides of this abscess and their union is prevented, the parietes of the cavity become callous, the orifice becomes small, contracted, and indurated, and the condition known as **Fistula in Ano** is induced. To facilitate the adhesion of these parts, by exciting proper inflammatory action, and bring the sides of the abscess in contact, so that they may be kept at perfect rest, is the object of the operations performed for the relief of this complaint. To accomplish this, two principal means are resorted to: 1. The ligature. 2. Incision.

The **Ligature.**—The application of a ligature to a fistula, so as to induce the division of the sphincter muscle by ulceration and the formation of healthy granulations, may be effected in various ways; and by the use of the following instruments of Gibson, it is rendered a simple and not very painful operation.

Operation of Gibson.*—A silver canula, five inches long and an eighth of an inch wide, slightly curved, so as to convey a watch-spring ten inches long, with a bulb at one end and an eye at the other, and with a steel stylet, Plate LVIII. Figs. 24, 25, being first prepared, the surgeon should gently probe the course of the fistula, and if it is incomplete, pass in the canula, with its stylet retracted, passing the left forefinger into the rectum, and pressing the point of the canula against the side of the gut, where it is supported by the finger; then push forward the stylet, puncture the wall of the rectum, withdraw the stylet, and pass the canula through the opening thus made, until it touches the finger in the rectum. On passing the watch-spring, armed with a ligature, into the canula, carry the spring into the cavity of the gut, and bring one end out of the anus; when, the canula and watch-spring being removed, the other end of the ligature will be left coming out of the fistulous orifice, Plate LXIV. Fig. 7. The two ends being now loosely tied, the patient may walk about until the ligature ulcerates out and escapes, as during this time the formation of granulations will generally have removed the complaint.

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* Institutes of Surg., vol. ii. p. 164.

Operation by the Knife.—Empty the bowels, and place the patient upon the side next to the fistula; pass the left index finger into the rectum; pass the bistoury into the fistula; bring its point to touch the finger, and, withdrawing the two, lay open the gut and the cavity of the abscess by dividing the levator ani longitudinally, and the sphincters transversely. Then keep the anal orifice of the fistula moderately open by introducing charpie or lint until it heals from its upper end by the formation of new granulations, Plate LXIV. Fig. 4.

Remarks.—Among the various methods of operating for fistula in ano recommended by surgeons at various periods, there is no difference in the indications to be accomplished, though individual peculiarity has suggested a variety of instruments. Of all these, but one demands special notice, and that is the sheath bistoury of Wheatley and Physick. This instrument resembles the ordinary sharp-pointed bistoury, but has a sheath attached upon the blade, which covers its cutting edge as well as its point, but may be shifted at pleasure. This sheath saves the patient the pain likely to be created by passing the sharp edge and point against the sides of the fistula in introducing the instrument, a matter of some moment where etherization is not practiced. The position of the patient upon the side, with the limb of the sound side flexed and that of the affected side extended, Plate LXIV. Fig. 4, as pursued by the French surgeons, is also better than that upon the hands and knees, or leaning over a table or bed. In the latter position, the pain caused by the incision is apt to force the patient away from the surgeon, in consequence of which the forefinger of the operator is liable to injury. Such a position is also incompatible with etherization, which, in an operation upon an inflamed and sensitive part, is essential to the comfort of the patient. Where time is not an object, or in tuberculous patients, the ligature is best adapted to the cure; but incision is the most prompt and certain.

When the surrounding parts and the edges of a fistula are indurated, the French surgeons are accustomed to pare them off, and leave the wide wound thus made to heal by granulations. But, in the majority of cases, such a proceeding only increases the suffering of the patient, and delays the cure. In very callous cases, a slight paring of the edges of the incision may expedite the treatment; but, in most instances, nature is capable of removing the induration.

For many years, surgeons have entertained the opinion that in pulmonary tuberculosis the existence of a fistula in ano should be sedulously cherished, as it was thought to exercise a beneficial effect upon this disorder. This opinion has, however, been gradually yielding to more correct views of the origin and progress of pulmonary tubercles, and the beneficial revulsive influence of anal fistula is now justly doubted.

In the number of the *Buffalo Med. Journal* for February, 1858, P. H. Strong has ably argued against the correctness of this opinion, and contends that the proper object for therapeutics, in tuberculous patients with fistula, is to remedy the dyscrasy on which it depends, and not to attempt to eliminate the material by a continuous suppuration, as in fistula. The better plan of treating fistula in ano, in tuberculous patients, is to favor the prompt healing of the fistula by the use of the ligature, and improve the general health of the patient by tonics and chalybeates.

§ 8.—Stricture of the Rectum.

Stricture of the Rectum is often alluded to as a disease existing independently of other disorders, though most frequently it is due to the growth of the carcinomatous deposits just alluded to. An induration may, however, be caused by the syphilitic disorder of the bowel, which is due to unnatural intercourse, as is sometimes seen in Europe, or it may be created by a true tuberculous deposit in the cellular tissue, or in the adjacent glands, which, by forming tumors, may press upon and obstruct the calibre of the bowel. Very often, however, the stricture of the rectum, which is supposed to exist, consists merely of the spasmodic contraction of the sphincter ani muscle that has been already described in connection with the subject of fissure of the anus.

Symptoms.—The symptoms of stricture show themselves chiefly in the obstruction of the course of the feces, in disordered digestion, in hemorrhoids, and in the development of fistula in ano.

Treatment.—The treatment is chiefly palliative, consisting in the dilatation of the anus by the cautious use of bougies, and in attention to the digestion, while the pain is relieved by the free use of anodynes.

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OPERATIONS ON THE PENIS.

New Method of performing the Operation of Phymosis, by George Bushe, M.D. New York.—*New York Medico-Chirurgical Bulletin*, vol. i. p. 224. 1832.

Induration and Enlargement of the Penis, with a new Mode of Amputating that Organ, by Thos. L. Ogier, M.D. Charleston.—*Am. Journ. Med. Sciences*, vol xviii. p. 382. 1836.

On Amputation of the Penis, by John P. Mettauer, M.D. Virginia.—*Boston Med. and Surg. Journ.*, vol. xvii. p. 197. 1837.

A Case of Imperforate Prepuce, by D. J. C. Cain, M.D. Charleston.—*Am. Journ. Med. Sciences*, vol. xiii. N. S. p. 521, 1847; also *Southern Journ. of Med. and Pharm.*, Jan. 1847.

Malformation of the Genito-Urinary Apparatus, by L. A. Dugas, M.D. Georgia. —*Southern Med. and Surg. Journal*, vol. v. N. S. p. 193. 1849.

Amputation of the Penis for Cancer, (healed readily, but disease reappeared at Pubis in seven months,) by Wm. E. Horner, M.D. Philadelphia —*Med. Examiner*, vol. vii. N. S. p. 99. 1851.

Report of a Case of Phymosis, (operated on by Ricord's Operation and Serresfines instead of Suture,) by Juriah Harriss, M.D. Augusta, Ga.—*Southern Med. and Surg. Journ.*, vol. viii. p. 21. 1852.

Gangrene of the Penis, supervening upon an Attack of Typhoid Fever in a Patient suffering at the time with Gonorrhœa, by T. G. Richardson, M D. New Orleans.—*New Orleans Medical and Surg. Journ.*, vol. xvi. p. 679. 1859.

ON DISORDERS OF THE MALE URETHRA.

Fistula in Perineo, attended with considerable loss of substance, cured by Lunar Caustic, by Wm. E. Horner, M.D. Philadelphia.—*Phila. Journ. of Med and Phys. Sciences*, vol. ix p. 141. 1824.

On the Treatment of Strictures of the Urethra by a Perineal Incision, with Cases, by Horatio G. Jameson, M.D. Baltimore. (First operation in 1820.)—*Am. Med. Recorder*, vol. vii. p. 251. 1824.

Description of an Instrument (with a Plate) for dividing Strictures of the Urethra, by E. R. Chew, M.D. Louisiana.—*North American Med. and Surg. Journ.*, vol. v. p. 341. 1828.

Practical Observations on Stricture of the Urethra, by H. G. Jameson, M.D. Baltimore.—*Am. Med. Recorder*, vol. xii. p. 329. 1828.

Case of Stricture of the Urethra, (treated by a Perineal Section,) by Horatio G. Jameson, M.D. Baltimore.—*Maryland Med. Recorder*, vol. i. p. 177. 1829.

Operations for Artificial Urethra, (successful,) by John C. Warren, M.D. Boston. —*Boston Med. and Surg. Journ.*, vol. ii. p. 321. 1829.

Treatment of Stricture of the Urethra by rapid and free Dilatation, by Paul F. Eve, M.D. Georgia.—*New York Med. Times*, vol. iv. p. 301. 1832.

On Hypospadias, with Cases, by George Bushe, M.D. New York.—*New York Medico-Chirurgical Bulletin*, vol. ii. p. 1. 1832.

Case of Stricture of the Urethra strongly simulating Lithiasis. by N. R. Smith, M.D. Baltimore.—*North American Archives Med. and Surg. Sciences*, vol. i. p. 185. 1835.

Complete Suppression of Urine from obliteration of the Membranous portion of the Urethra, Puncture of the Bladder above the Pubis, Perineum opened and a new Urethra formed, (cured,) by E. Geddings, M.D. Baltimore.—*Am. Archives Med. and Surg. Sciences*, vol. i. p. 31. 1835.

A Case of Stricture of the Urethra, cured by Bougies of the Bark of the Slippery Elm Tree, by Wm. Waters, M.D. Maryland. —*Am. Journ. Med. Sciences*, vol xxv. p. 321. 1839.

Practical Observations on those Malformations of the Male Urethra and Penis, termed Hypospadias and Epispadias, with an anomalous Case, by John P. Mettauer, M.D. Virginia.—*Am. Journ. Med. Sciences*, vol. iv. N. S. p. 43. 1842.

Employment of Gutta-Percha in the treatment of Strictures, by Henry J. Bigelow, M.D. Boston.—*Boston Medical and Surg. Journ.*, vol. xl. p. 9. 1849.

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A. Wragg, M.D. Savannah, Ga.—*Charles-Med. Journ.*, vol. viii. p. 799. 1852.

Cure of a Laceration of the Urethra, by J. Gautier, M.D. Alabama.—*Am. Journ. Med. Sciences*, vol. xxviii. N. S. p. 413. 1854.

Perineal Section for Stricture of the Urethra, by F. D. Lente, M.D. New York. —*Am. Journ. Med. Sciences*, vol. xxix. N. S. p. 574. 1855.

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An Easy Mode of Constructing Bougies, by P. H. Cabell, M.D. Alabama.—*Am. Journ. Med. Sciences*, vol. xxxii. N. S. p. 578. 1856.

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Case of an Anomalous Sac or Pouch, connected with the membranous portion of the Urethra, by C. E Isaacs, M.D. New York.—*New York Journ. of Med.*, vol. v. 3d S. p. 9. 1858.

Stricture of the Urethra, treated by Syme's Operation of Perineal Section, by W. S. Halsey, M.D. Philadelphia.—*American Journ. Med. Sciences*, vol. xxxvi. N. S. p. 72. 1858.

Constitutional Effects Produced by Substances introduced into the Urethra, by J. L. Crawcour, M.D. New Orleans.—*Am. Journ. Med. Sciences*, vol. xxxvi. N. S. p. 290. 1858.

History of Compressed Sponge for the Treatment of Strictures of the Urethra, Rectum, etc., also Morbid Growths and other Affections, by J. P. Batchelder, M.D. New York.—*New York Journal of Medicine*, vol. vi. 3d S. p. 301. 1859.

Diseases of the Prostate Gland, by Valentine Mott, M.D. New York.—*Southern Med. and Surg. Journ.*, vol. xv. N. S. p. 24. 1859.

OPERATIONS ON THE TESTICLE AND CORD.

New Operation (Ligation of the Arteries) for Circocele, cured, by H. G. Jameson, M.D. Baltimore.—*Am. Med. Recorder*, vol. viii. p. 271. 1825.

Operation for a Tumor of the Scrotum, (Omental Hernia, cured,) by Jno. C. Warren, M.D. Boston.—*Boston Med. and Surg. Journ.*, vol. i. p. 237. 1828.

Case of Sarcocele successfully treated by tying the Spermatic Artery, by Horatio G. Jameson, M.D. Baltimore.—*Maryland Med. Recorder*, vol. ii. p. 607. 1831.

Extirpation of the Testes and Penis affected with Cancerous Disease, by J. C. Hall, M.D. Washington.—*Am. Journ. Med. Sciences*, vol. x. p. 395. 1832.

Extirpation of the Testis; death from Phlebitis, by Nathan R. Smith, M.D. Baltimore.—*North American Archives Med. and Surg. Sciences*, vol. ii. p. 77. 1835.

On Tubercles of the Testis, (Castration, etc.,) by Henry H. Smith, M.D. Philadelphia.—*Med. Examiner*, vol. iii. p. 360. 1840.

Varicocele, and Extirpation of the Testis, by F. H. Hamilton, M.D. Rochester. —*Boston Med. and Surg. Journ.*, vol. xxv. p. 153. 1841.

Treatment of Diseases of the Testicle, by Compression, in November, 1803, by P. S. Physick, M.D. Reported by Edward Hartshorne, M.D. Philadelphia.—*Am. Journ. Med. Sciences*, vol. iii. N. S. p. 258. 1842.

Practical Observations on the Radical Treatment of Varicocele, by John Watson, M.D. New York.—*Am. Journ. Med. Sciences*, vol. x. N. S. p. 316. 1845.

New Operation (Incision and Ligation) for the Radical Cure of Varicocele, performed successfully eight times, by S. D. Gross, M.D. Louisville.—*Am. Journ. Med. Sciences*, vol. xvi. N. S. p. 327. 1848.

Castration of an Enlarged and Irritable Testis, by M. G. Delaney, M.D. U. S. N. —*Am. Journ. Med. Sciences*, vol. xvi. N. S. p. 292. 1848.

Extirpation of the Left Testicle, (etherized, cured.) by W. E. Horner, M.D. Philadelphia.—*Med. Examiner*, vol. vii. N. S. p. 33. 1851.

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PART XVI.

DISORDERS OF, AND OPERATIONS ON, THE EXTREMITIES.

GENERAL OPERATIONS ON THE EXTREMITIES.

THE **Upper and Lower Extremities**, being composed of several tissues which are analogous to those found in other regions of the body, are liable to many similar complaints, and sometimes require operations which are the same in principle as some of those already described; thus, the removal of tumors, the relief of deformities arising from the cicatrices of burns, the ligation of arteries, or the resection of bones, are very much the same in all parts of the body, and must be regulated by the same general rules, the operations on these regions only differing in accordance with the anatomical relations of the portion of the body in which they are performed. It will consequently be unnecessary, in this portion of the work, to do more than describe such modifications of these operations as are required by the position and functions of the extremities; and the reader is therefore referred to the preceding pages for any operative directions not specially required in connection with this region.

Two classes of operations are performed upon the extremities: one including all those of a general kind required for the relief of the diseases of the superficial tissues, as the tendons and blood-vessels; the other referring to such as are deeper seated, as the bones or the entire limb.

The class of operations of a general character which may be assigned to the first of these limits, and not previously described, embraces such as are required for the relief of deformities, as well as those due to disorders of the blood-vessels and nerves; the second including such changes of structure as are usually the result of injury, and necessitate amputation.

CHAPTER I.

CLUB-FOOT.

AMONG the most marked of the deformities seen in connection with the more superficial tissues found in the extremities, is **Talipes**, or *Club-foot.* This is a very common complaint, and one which, as it generally makes its appearance at birth, or in young children, causes great anxiety to the parents. As a deformity, it presents certain details applicable to the whole class not only of club-feet, but of deformities in general; and a very slight examination of the subject will demonstrate that club-foot has many points in common with strabismus, with spinal curvature, (muscular,) with certain forms of torticollis, with club-hand, and all other similar deformities. Before, then, we proceed to study the symptoms and treatment of the disorder in question, it is right that allusion should be made to some of the points connected with the action of the muscles.

As deformities from muscular action are due to the general law that the two sides of the body are equal, and that the muscles of each side have an equal amount of power—due allowance being made for the slight predominance of those of the right side over those of the left, on account of their being more exercised—there are certain general principles applicable to their treatment which should be here alluded to. For instance, it is well known that where the muscles of one side are contracted, those of the opposite portion are usually lengthened; and that while those of one side are overacting, those which oppose them must be acting with diminished power. In all these cases, therefore, it will become the duty of the surgeon not only to overcome this excessive action and weaken the power of the contracted muscles, but also to stimulate and favor the contractile force of the elongated muscle, while he hardens the skin on points where pressure is to be made, in order that it may be better borne if mechanical appliances are to be employed.

Symptoms.—Club-foot is a deformity in which there is more or less deviation in the axis of the foot from the natural line in one of several directions: thus the toes may be depressed, and the heel elevated; or the toes may be turned inward or outward; or various modifications and combinations of these conditions may be present.

Etiology.—The causes of club-foot are varied, and by no means thoroughly understood. By the older writers, the affection was ascribed to various causes, all more or less absurd; thus, it was supposed to be due to the fact that, during pregnancy, the mother had seen something disagreeable, or suffered so as to induce a contraction in the toes of the fœtus; and this absurdity is still popularly believed in, as I was once told by a lady of high education, that a club-foot in her child, to which she called my attention, was caused by her having stumped her toe when about the third month of pregnancy. By some it has been ascribed to unnatural or irregular contractions of the uterus upon the fœtus, and by others to the umbilical cord having accidentally been wound around the limb; and this latter may sometimes have been the active agent in producing the deformity, though the general cause applicable to nearly every case of congenital club-foot is want of proper innervation; and the student who would truly understand the pathology of the disorder, must start with this idea.

That so many infants with club-foot also show more or less deviation in the spinal column, laterally, and even sometimes suffer from spina bifida, or hare-lip, would seem to point out the fact that, in some cases, there is more than a mere local disorder.

Varieties.—Five varieties of the complaint have been made by authors:—

1. The first and simplest is designated as **Pes Equinus**, because the individual laboring under the complaint, when he comes to walk, walks as a horse does, upon the end of the phalanges, the heel being elevated and the toes depressed. This variety, though sometimes existing alone, is very generally more or less combined with those which will next be brought under consideration.

2. The second variety is the reverse of pes equinus; as here we have a depression of the heel and an elevation of the toes, so that the patient stumps along upon his heel, this being the variety known as **Pes Calcaneus.**

3. The third variety is one of the most common, and is that in which there is a turning inward of the metatarsal bones and of the toes, as well as an elevation of the heel; and this form has received from writers the designation of **Varus.**

4. The fourth variety is called **Valgus**; and here the toes and the supporting metatarsal bones are turned outward; this condition is therefore directly the reverse of varus, but, like it, generally combined with more or less elevation of the heel.

5. The last variety is **Pes Plantaris,** a deformity in which there is a doubling under of the toes beneath the sole of the foot, so that the individual walks upon his instep, or upon some part of the upper portion of his foot

That much may be done toward remedying these various conditions by mechanical means, will readily be understood by any one who will reflect upon the great changes produced by pressure and bandaging upon the foot of the Chinese lady, and it is therefore but reasonable to suppose that means so potent in the production of deformity in the sound limb cannot but be useful, if judiciously applied, to the case of one that is diseased.

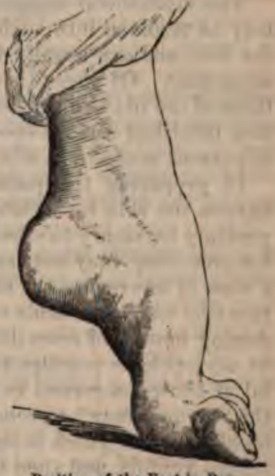
SECTION I.

PES EQUINUS.

In taking up the special consideration of these different varieties of club-foot, attention may first be given to **Pes Equinus,** as the contraction of the gastrocnemius and soleus muscles, or a certain amount of pes equinus, not unfrequently complicates varus and valgus. In order that the student may understand this or any other variety of club-foot, a brief allusion to the structure of the healthy foot will be useful.

Anatomical Relations.—In the foot we have the articulation of the bones of the leg with the astragalus, the latter bone articulating below with the os calcis, and forward with the scaphoides, while the os calcis, which projects posteriorly and inferiorly, forms the heel, and gives an insertion to the tendo-Achillis. The calcis articulates anteriorly with the cuboid, which supports the fourth and fifth metatarsal bones; while the scaphoid articulates anteriorly with the three cuneiform bones, which support the first, second, and third metatarsal bones.

Fig. 442.



Position of the Foot in Pes Equinus in the adult.

Any one of the varieties of club-foot, after it has existed for a short time, will cause displacements of these bones of the tarsus, so that the articulating surfaces will be much modified, or it may even go to such an extent that the appropriate articulating facets of the bones will no longer present to each other. Besides these changes in the bones, the modifications in the action of the muscles themselves require special study. Thus in pes equinus, we have an over-action in the gastrocnemius and soleus, which induces a shortening in these muscles that draws up the heel by means of the insertion of the tendo-Achillis into the os calcis, Fig. 442. The antagonistic muscles, on the other hand, are lengthened. As a result, changes must necessarily be experienced in the limb, the tibia no longer resting upon the articulating surface of the astragalus, owing to the violent flexion of the foot, but being seated upon this bone posteriorly to its usual articulating face, or forming a new articulating surface upon the os calcis itself. Like displacements also occur in the relations to each other of all the tarsal bones, as can be readily understood. We have, then, in a case of pes equinus, first a deviation in the normal contractility of the muscles concerned; then a deviation in the articular faces of the bones, which are no longer presented properly to each other; and next, various deviations in the ligaments of this part, these becoming irregularly stretched, in order to accommodate the bones in their new position. When all these facts are taken into consideration, it will be understood that mechanical means for the treatment of such a deformity can only overcome it if used patiently, and for a long time, it being absolutely essential to a cure that some treatment should be persevered in until the extended and relaxed ligaments and the new facets of the bones have resumed their normal relations, a fact which should not be lost sight of in all cases of club-foot.

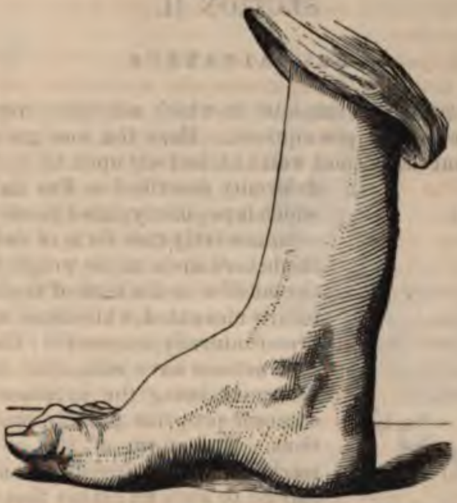
Post-mortem Appearances.—A dissection of a case of pes equinus shows that, among the muscles, the gastrocnemius and soleus, with the plantaris and the plantar fascia, the tibialis posticus, and the peronei muscles, and especially the peroneus longus, are all more or less contracted, their antagonistic muscles being weakened, relaxed, and extended.

Treatment.—The treatment of pes equinus, as well as that of all the varieties of club-foot, will depend somewhat on the age of the patient and the duration of the deformity. In the infant, much may be accomplished by directing the nurse to bend the foot daily in the opposite direction to that to which it inclines, until the child is about six months old. In the older child, or in the youth, more powerful means will be required, and some form of apparatus should therefore be promptly prepared. When these are applied, the surgeon should either trust entirely to them, or combine the apparatus with such operative measures as have for their object the division of the contracted tendon and the subsequent elongation of the effused and organized lymph that unites its divided extremities.

The mechanical means adapted to the treatment of simple pes equinus may be resolved into such measures as will elevate the toes and bring down the heel, and are usually designated as the club-foot shoe, or as the club-foot apparatus. Of these there are a great variety, most of which are modifications of the old shoe of Scarpa, though the progress of the mechanic arts has now furnished several specimens of a very neat and efficient mechanism. The apparatus made by Kolbè will be again alluded to, Figs. 450, 451.

In preparing the patient for wearing any of these, the surgeon should harden the skin by bathing it daily in strong oak-bark tea, in order that the pressure necessary to effect his object, and which must necessarily be kept up for some time, may not cause a troublesome ulceration in the foot. Then, with a view of increasing the efficacy of the mechanical measures, and saving much valuable time—valuable because while the deformity exists the bones are becoming more and more difficult to shift from their abnormal position—it may be advisable to practice the division of the tendo-Achillis as the most powerful of those concerned in the production of this deformity. The division of this tendon may be accomplished by a little knife, which is designated as a *tenotome*, and which is introduced flat beneath the skin between it and the tendo-Achillis, and then turned so as to cause its edge to present toward the tendon, when the foot being put upon the stretch, the tendon will be brought up against the knife and divided, by forcibly extending the foot, the division of the tendon being recognized by an audible snap. The limb being now left at rest, the ordinary changes of subcutaneous wounds ensue, such as the effusion of blood, the liquid portions of which are shortly absorbed, after which there is an effusion of lymph, which, becoming organized, unites the two cut extremities of the tendon. This new tissue, when first formed, is elastic and extensible, and if at this period mechanical measures are applied, the heel may gradually be brought down, and the deformity overcome in a few days. But the rationale of this plan of treatment should never be lost sight of; for if the surgeon ignorantly brings the heel down, by mechanical means, immediately after the division of the tendon, non-union may be the result, or so much new structure may be formed, that the increased length of the tendon will be greater than is desirable to restore the equipoise of the limb, and the patient be lamed for life, being thus rendered unable to contract his gastrocnemius muscle sufficiently to raise the heel from the ground.

Fig. 443.



View of a Foot after the Heel is brought down in Pes Equinus.

The surgeon should, therefore, delay about five days after the operation of tenotomy before mechanical means are employed, and only apply them very gradually at first. If the heel be brought down one line a day, in less than two weeks it will have descended an inch. *Gradual* extension, therefore, is amply sufficient, and it is only by such pressure and patient perseverance that the cure can be accomplished.

After the heel is thus brought to the ground, the patient, though well able to walk, will generally present some deviation of the foot, if it is closely examined, Fig. 443.

§ 1.—Phalangeal Variety of Pes Equinus.

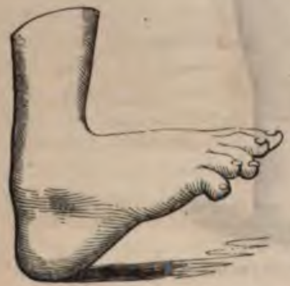
In connection with pes equinus, it is necessary to allude to what is called the **Phalangeal** variety of the complaint. This is simply the variety of the disease seen in children who have never walked, in whom the toes point directly downward, and is usually seen in children under twelve months of age. In connection with this subject I would allude to one cause which sometimes produces this variety in children who had originally perfectly healthy feet, and that is the practice, now fortunately going out of fashion, but recently very popular, of amusing children by suspending them in the apparatuses popularly called "baby jumpers." In this the child was suspended from a hook in the ceiling, by a little contrivance which surrounded the body, and was so arranged that it could barely touch the floor with its toes. Then the suspending cords being elastic, the least motion of the child produced a dancing up and down, which seems to have delighted equally the infant and the mother or nurse who had it in charge. But in consequence of the foot being kept constantly extended, and the heel elevated, more than one instance has occurred, within my own knowledge, in which a spasmodic contraction of the muscles in the back of the leg took place, and a temporary phalangeal pes equinus was produced.

SECTION II.

PES CALCANEUS.

The second form of the complaint to which attention may next be given is precisely the reverse of pes equinus. Here the toes go up and the heel comes down, so that the patient walks exclusively upon his heel, producing the deformity described as **Pes Calcaneus**, or that which is popularly called hooked-foot. This is a comparatively rare form of deformity. The os calcis here sustains the weight of the body, and the muscles on the back of the leg are preternaturally elongated, while those upon its front are preternaturally contracted; the muscles whose contractions have most effect in producing the deformity being the extensor communis, the extensor proprius pollicis, and the tibialis anticus. This form of the complaint is very marked in some instances, and is sometimes carried to such an extent that the anterior face of the os calcis looks upward instead of forward. In these cases, as in others, there are modifications of the articulating surfaces of the os calcis and of the bones connected with it, as the os calcis no longer articulates in the normal manner with the cuboid, while the bones of the tarsus are generally displaced. Of course, there are also changes in the ligaments of the part, caused by the modified position of the bones; thus, the ligaments upon the bottom of the foot will be found to be elongated, while those on the dorsal surface will be shortened.

Fig. 444.



A side view of the Right Foot in Pes Calcaneus. (After Nature.)

Treatment.—More may be done in the treatment of this complaint by prompt mechanical means than in most of the other varieties, as the form of the foot enables the pressure adapted to the treatment of pes calcaneus to be so readily borne that this form presents few difficulties if treated at an early period of life. In order to bring the foot down, such measures as were directed for the relief of fracture of the os calcis may be resorted to, or a club-foot shoe applied, so as to depress the toes and elevate the heel.

SECTION III.

VARUS.

In **Varus,** the toes and metatarsal bones are turned inward, Fig. 445, and the heel is almost always elevated, this variety being usually complicated with a certain amount of pes equinus. The changes in the bones and ligaments, in this form of the complaint, are very marked, and due often to an arrest of development in the bones of the tarsus, this being conjoined not unfrequently with a deficiency of calcareous matter in the bones concerned, so that they readily bend, a condition well illustrated by a specimen in the Wistar and Horner Museum of the University of Pennsylvania. The principal muscles contracted in this form of the complaint are the gastrocnemius and soleus, and the tibialis anticus. The tibialis posticus and the abductor pollicis are also contracted, while the peronei and other muscles antagonistic to those just named are generally lengthened.

Fig. 445.

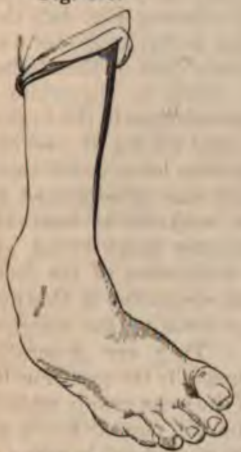


Fig. 446.

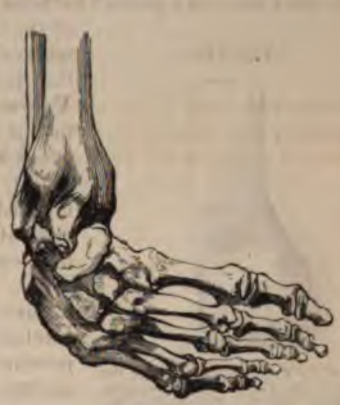


Fig. 445.—Outside view of Varus in the adult, the deformity not very marked. (After Miller.)
Fig. 446.—View of the Imperfect Development and Displacement of the Bones in Varus. (After Miller.)

Fig. 447.

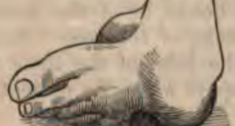


Fig. 448.

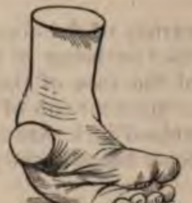


Fig. 447.—Outside view of Varus, showing the Bursal Pad or Tumor upon which the patient walks, this pad presenting a full, rounded, cushion-like point of support. (After Nature.)
Fig. 448.—View of the Sole of the Foot in a marked case of Varus, showing the contraction of the plantar fascia, etc. (After Nature.)

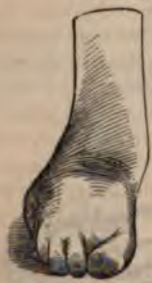
As the disease continues and the child begins to walk, certain changes will be noticed in the external tissues, consequent upon pressure. Thus, there will usually be found a thickening of the skin, and true hypertrophy of this tissue at the point at which the foot comes in contact with the ground. Sometimes a bursa—Fig. 447—forms between the thickened skin and the deeper-seated parts.

SECTION IV.

VALGUS.

Valgus is a very rare form of club-foot. The disposition here is to turn the toes and metatarsal bones outward; and this variety is, therefore, just the reverse of varus. The changes produced by this deformity are readily understood: thus there is a perfect flattening down of the tarsus, Fig. 449, the sole of the foot becoming as flat as that of a negro, while there is the total loss of that fullness of the instep which exists in the white man. Valgus is also more common in the negro than in the white man, and among the several negroes known to me who labor under this complaint, almost every case is combined with a marked degree of weakness of intellect, the patient being moreover knock-kneed, in connection with the inclination of the foot outward. The muscles contracted in this deformity are those antagonistic to the muscles contracted in varus. They are generally the peronei muscles, especially the peroneus longus and the muscles of the same group, while there is an elongation of the plantar fascia and of most of the muscles contracted in varus. The changes affect here principally the astragalus and the cuboides among the bones of the tarsus.

Fig. 449.



A front view of valgus, showing the eversion of the Toes, and the inversion of the Heel, with the flattening of the Instep. (After Nature.)

SECTION V.

PES TALUS OR PLANTARIS.

The last variety of club-foot is a very rare one, and is called **Pes Talus** or **Plantaris,** the foot being so deformed that the patient walks upon the dorsal surface of the toes, of the metatarsal bones, or of the tarsus; in other words, walks upon the top of the foot instead of the sole. Sometimes this form is combined with varus, and then the joint of the little toe, with its metatarsal bone, becomes the point of support when the patient walks.

SECTION VI.

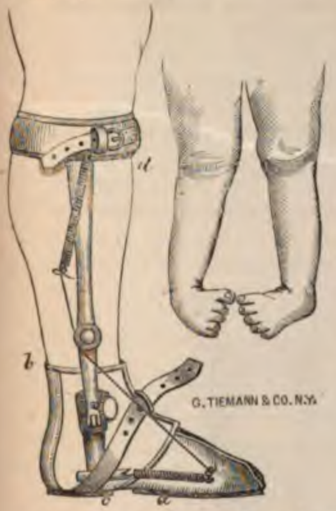
TREATMENT OF ALL THE VARIETIES OF CLUB-FOOT.

In the treatment of any of these varieties of club-foot, much may be done, while the infant is yet in the arms, and too tender to be treated by mechanical contrivances or by operative means, if the nurse, by proper manipula-

Extract from the "Medical Record," New-York, Aug. 16th, 1869.

IMPROVED CLUBFOOT APPARATUS FOR TALIPES VARUS.

THE following is a description of a very neat, effective, and comparatively cheap apparatus for talipes, devised by Messrs. Geo. Tiemann & Co., instrument-makers in this city.



The sole of this strong leather shoe is of metal, with a joint near the heel, allowing lateral motion. A strong and durable spiral spring, as shown in the cut (*a*), draws the foot outward by a constant, elastic, and easy traction. This pressure is increased or decreased at will, by fastening the spring in a series of sockets (*c*).

The single outside upright steel bar with joints at the ankle, is fastened round the limb below the knee-joint, and so constructed that the screw at the ankle-joint forces the foot flat upon the floor, which foot in almost all cases is turned under as indicated by the sketch. The spiral spring (*d*), being attached to a cat-gut cord (passing round a pulley at the centre of the bar and fastened near the toes upon the outside of the foot), elevates the toes and stretches the tendo Achillis, at the same time drawing the foot to its natural position.

The shoe is well padded, and as there is no metal in the heel-cap, no excoriation is occasioned. The contraction of the leather above the heel prevents the shoe from slipping off, (always so difficult to retain in fleshy infants). The straps round the instep depress any undue prominence of the arch of the foot, and within the shoe a broad and well padded tongue keeps the toes flat upon the sole of the shoe.

This apparatus resembles much the regular shoe, and shows no deformed appearance.

A very simple and light night shoe to keep the foot in the same position gained by above shoe during the day-time, is of much service.

FOR TALIPES VALGUS the same principle, but with reversed action, is applied.

In ordering the above Shoe please send the following measures:

1) Length of sole of foot, ... inches
2) Circumference of calf (*d*), ... "
3) " " instep (*c*), ... "
4) " " ball of foot (*a*),.... .... "
5) " above ankle (*b*),........ .... "
6) Length from sole to upper part of calf (*d*),....... .... "
7) Right or left foot?
8) Talipes—varus or valgus?

For Sale by

GEO. TIEMANN & CO.

F. A. STOHLMANN, EDWARD PFARRE,

Manufacturers of Surgeons' Instruments and all kinds of
APPLIANCES FOR THE MECHANICAL TREATMENT OF
Deformities, Debilities and Deficiencies of the Human Frame.
67 Chatham-Street, New-York.

tions with her hands, will draw the toes up carefully from time to time if the form of the affection be pes equinus, or bend the instep outward, if it is a case of varus. As the child approaches the age at which mechanical contrivances can judiciously be applied—say from six to twelve months—the skin should be hardened by soaking it in oak-bark tea, as before directed. In any of these varieties, where the heel is elevated, operative measures—as the division of the tendo-Achillis, before alluded to—may be demanded. After which, or from the first, if operative means are not used, some mechanical apparatus will be required, these being persevered in for many months, and a firm support, in the shape of a stiff boot, worn for years subsequently.

One of the best forms of apparatus that I know of is a modification of Scarpa's shoe, which can be made to adjust itself, by means of a screw, to any angle of inclination required, Fig. 450. When this contrivance has been fastened to the foot, by means of properly adjusted and padded straps, the motion of a screw, by changing the position of the sole to which the foot is strapped, can be made to bring the foot gradually into any position which may be required, while the child will yet be able to walk about, as the apparatus is so jointed as to permit it.

Fig. 450.

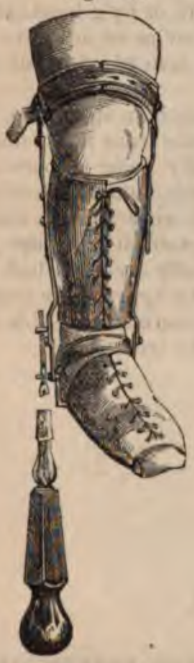


Fig. 451.

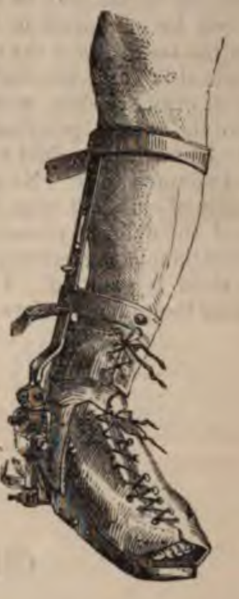


Fig. 450.—A view of Kolbé's Club-foot Apparatus.—This ingenious instrument is applicable to *all* the forms of Club-foot, the position of the foot being changed by means of the key attached to the shoe, thus presenting an advantage over some other forms of apparatus, that, when the key is removed, the friends cannot displace the angle of the apparatus, although they can remove it entirely from the foot. It also can be worn while the patient walks about, which is not the case with some other varieties of the adjusting shoe. (Af[illegible] Nature.)

Fig. 451.—A three-quarter view of Kolbé's Adjusting Shoe for Varus.—This apparatus is especially applicable to Varus, and may be adjusted to any angle of the foot, and deviation of the heel, by means of a universal joint, though it will not permit the patient to walk.—1. Pivot for key to move the joint. 2. Joint which revolves three-quarters of a circle laterally and antero-posteriorly. (After Nature.)

For varus, and especially for a case in which no effort has been made to bring the metatarsal bones into the proper line, a special apparatus will prove useful, and sufficient to accomplish the cure, without tenotomy or any incision of the plantar fascia. As in this form of club-foot it is desirable that the patient should not walk, lest one of the pads, formed by the bursa, be created, and subsequently make a deformity, an apparatus similar to that shown in Fig. 451 may be required, and Kolbè has so arranged this shoe that it may be adapted to almost any length of leg, or any inclination of the foot.

If a finished apparatus cannot be obtained, a ruder article, upon the same principle, might be fashioned, under the surgeon's direction, at any blacksmith's-shop in the country; and a very little mechanical ingenuity will often produce one that will prove quite as useful as that furnished in the cutler's shop.

Much good may be accomplished, in the simple cases of pes equinus, by surrounding the foot by a handkerchief, binding another around the calf, and then connecting the two together by a third, or by a bandage or string, which from day to day may be tightened; or strips of adhesive plaster or bandages can be employed, in the same way, instead of handkerchiefs, so as to draw the toes toward the tibia.

After from six to nine months' careful use of such an apparatus, the patient may wear an ordinary shoe, with club-foot or side irons if the foot has been brought to its correct position. But generally some apparatus will be required to be worn by a child a full twelvemonth, before the ordinary shoes can be well adapted to it. No greater error, however, can be committed in the treatment of club-foot, than an anxiety to establish a prompt cure. The reduction of the deformity must be very gradually accomplished, and maintained by continuous perseverance in the use of an appropriate boot for years, while the child is growing. It is therefore generally advisable to explain these facts to the parents before commencing the treatment.

CHAPTER II.

LIGATION OF THE ARTERIES OF THE EXTREMITIES.

THE **Arteries of the Extremities** may be ligated at any point of their course, and are to be operated on by the same rules as have been already stated in the chapter on Aneurisms.* The present account will, therefore, be limited to the operative steps required in the special application of the ligature to these vessels, the anatomical relations of each artery being given in connection with the operation practiced upon it. Compression as a means of curing aneurism is especially applicable to the blood-vessels of the extremities, and is to be accomplished in accordance with the views before given.†

In the description of these operations, I shall chiefly follow the rules of the French surgeons, as their fondness for practicing the ligation of arteries in the dissecting-room makes them excellent authorities, and I shall the more freely state these, as I have in every instance tested their accuracy annually with the operating classes of the University of Pennsylvania, and am able to furnish extended personal experience of the value of those hereafter given.

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* Vol. i. Part xi. p. 791.

† Vol. i. p. 797.

SECTION I.

LIGATION OF THE AXILLARY ARTERY IN THE AXILLA.

§ 1.—Anatomical Relations of the Axillary Artery.

The region of the **Axilla** has been differently described by authors, the French surgeons including in it nearly all the parts found between the arm and the clavicle, while others, among whom is Geddings, of Charleston,* limiting it to the triangular depression included between the upper part of the arm, shoulders, and side of the chest, which is formed by the edge of the pectoralis major in front, the latissimus dorsi and teres major muscles behind, as they tend to their insertion into the humerus, and by the ribs covered by the serratus magnus at the sides. As the parts about the clavicle have been already referred to, I shall adopt the latter limits.

The depth of the axilla depends very much upon the position of the arm and the obesity of the patient. When the arm is elevated perpendicularly, the head of the humerus is forced down, and nearly effaces the depression of the axilla, or sometimes renders it convex, and when the patient is fat, a deposit of adipose matter so fills up this space as barely to leave a depression.

In the region thus bounded by the pectoralis major muscle in front, and the latissimus dorsi behind, and which, in the adult, contains a luxuriant growth of hair, are to be found the axillary artery and vein, with their branches, as well as the nerves of the brachial plexus, together with the lymphatic glands; all these parts being united together by a loose connective tissue, and surrounded by fat.

The vessels and nerves of the axilla are so arranged as to form a plaited cord, the vein being generally anterior and internal, while the artery which was between the vein and the nerves near the clavicle is here so interlaced by the latter as to be difficult of access. The whole bundle of vessels and nerves traverses the axilla diagonally from above downward, and from within outward. The lymphatic ganglia occupy the course of the vessels, and are abundantly developed, Plate LXV. Fig. 1.

§ 2.—Ligation of the Axillary Artery.

The ligation of the **Axillary Artery** may be performed by various methods, some surgeons preferring one and some another. The two hereafter stated are amply sufficient, and as I have frequently tested their correctness, I recommend them to special consideration.

Operation of Lisfranc.—The patient lying down, and the arm forcibly extended, the distance between the latissimus and pectoralis major muscles should be divided by imaginary lines into three equal parts, and a longitudinal incision three inches long made through the skin and areolar

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* Amer. Cyclop. of Med. and Surg., vol. i. p. 559.

PLATE LXV.

LIGATION OF THE ARTERIES OF THE UPPER EXTREMITY.

Fig. 1. A view of the Anatomical Relations of the parts about the Axilla and upper portion of the Arm. 1. Brachial artery. 2. Director beneath it. 3. Median nerve. 4. Internal cutaneous nerve. 5. Ulnar nerve. 6. Brachial vein. 7. Axillary lymphatics. 8. Branches of the axillary artery. 9. Pectoralis minor muscle. 10. Pectoralis major. 11. The anterior margin of the axilla drawn back by a hook. 12. The cut edge of brachial fascia 13. The biceps muscle. 14. The coraco-brachialis. 15. Lymphatics.

After Bernard and Huette.

Fig. 2. Ligation of the Axillary Artery in the Axilla. 1, 2. Incision in the skin and fat. 3. That in the fascia. 4. The axillary artery raised on a director. 5. The axillary vein drawn back by a blunt hook forceps. 6. The median nerve. 7. The internal cutaneous nerve. *After Bernard and Huette.*

Fig. 3. Anatomical Relations of the Brachial Artery. 1. Brachial artery. 2. Radial artery. 3. Coraco-brachialis muscle. 4. Biceps muscle. 5. Median nerve. 6. Brachial vein. 7. Profunda minor artery. 8. Ulnar nerve. 9. Fascia formed over the artery at the elbow by the expansion from biceps tendon. 10. Median basilic vein. 11. Cephalic vein. *After Bernard and Huette.*

Fig. 4. Anatomical Relations of the superficial parts about the bend of the Arm. 1, 3. Cephalic vein. 2. Median cephalic. 4. Median vein. 5. Median basilic vein. 6. Brachial artery. 7. Biceps tendon. 8. Median nerve. 9. Ulnar nerve. 10. Radial nerve. 11. Branch of the external cutaneous nerve. 12. Main trunk of the external cutaneous. 13. Branch of the median nerve. 14. Branch of the internal cutaneous. 15. Its main trunk.

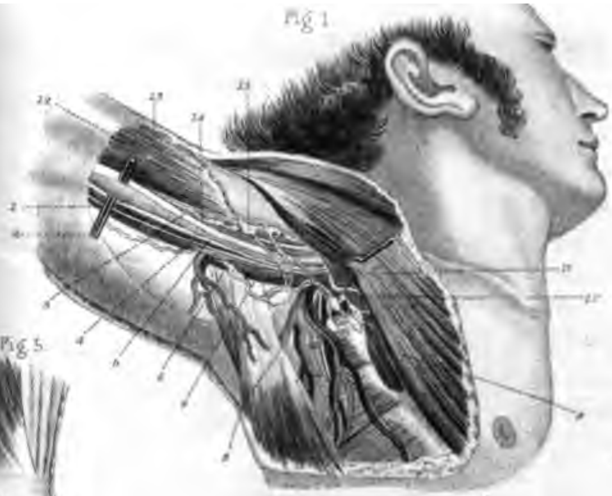
After Bernard and Huette.

Fig. 5. Anatomical Relations of the parts about the Wrist. 1. The posterior annular ligament. 2. Tendon of the extensor primi internodii. 3. Tendon of the extensor secundi internodii. 4. The radialis indicis artery.

After Bernard and Huette.

Fig. 6. Ligation of the Radialis Indicis Artery. 1. The skin. 2. The fascia. 3. The artery with the ligature beneath it. *After Bernard and Huette.*

Fig 1.



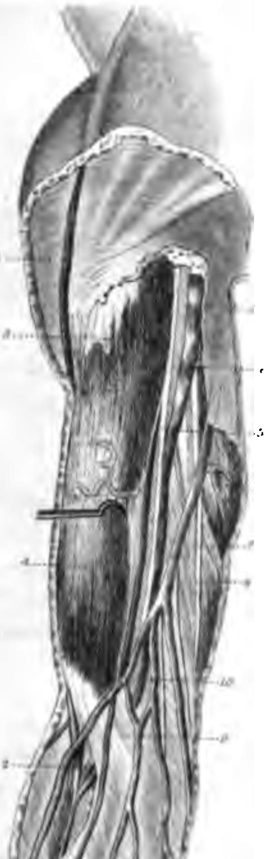


Fig 5.

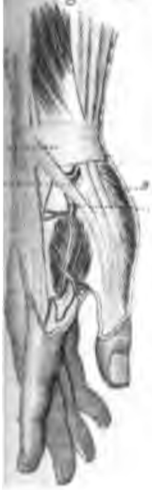


Fig 4.

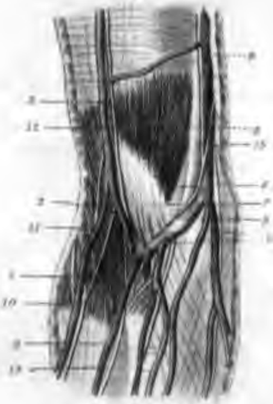


Fig 6.

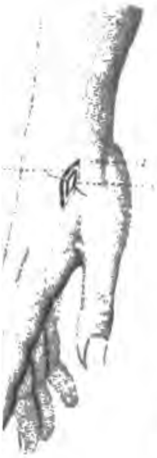
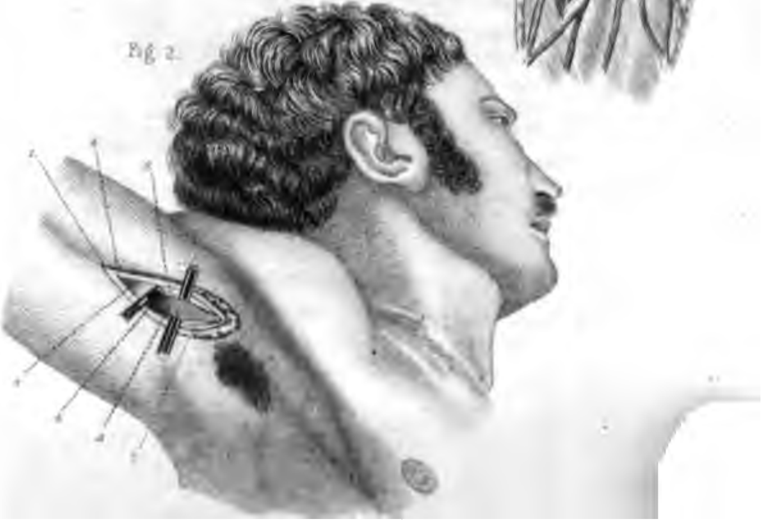


Fig 2.



tissue in a line corresponding with the union of the anterior and middle third of the axilla, Plate LXV. Fig. 2. The fascia, being then seized in the forceps, should be nicked and slit up on a director in the same direction as the external incision, or, if this does not expose the parts sufficiently, it may also be divided to a slight extent transversely. The nerves and vessels being now reached, the arm should be lowered, and the connective tissue around the vessels lacerated by the point of the director sufficiently to distinguish each part. The vein being then pushed to one side, seek on the anterior side of the axilla for the median nerve, underneath and inside of which is found the artery, which may now be secured by passing the aneurism-needle from behind forward, care being taken to avoid the axillary vein.

Remarks.—As it is often difficult to find the artery at this point, the operator, when he experiences a difficulty, should bear in mind the relations of the nerves to each other as well as to the surrounding parts, and, counting from the coraco-brachialis muscle backward and inward, find: 1st. The median nerve. 2d. The artery on the inner side and beneath this nerve. 3d. The internal cutaneous nerve. 4th. The ulnar nerve. 5th. The radial nerve.

Operation of Malgaigne.*—By a similar incision in the skin, or by one three-fourths of an inch from the anterior border of the axilla—as advised by Manec—the fascia is exposed, opened as before directed, and the internal border of the coraco-brachialis muscle sought for as the first indication. Division of the sheath of this muscle, on a level with its internal border, leads directly to the median nerve, which is the second indication; and inside and beneath it is the artery, which should be ligated as before directed.

Remarks.—The ligation of the axillary artery in the axilla may be demanded in cases of aneurism or wound of the brachial artery high up; the primary hemorrhage in the case of wounds being restrained by pressure of the subclavian artery upon the first rib, while, if the wounded vessel can be drawn out at the lower part of the wound, the ligature may be more readily applied than it can be higher up, where it is surrounded by nerves. In aneurism the same rule holds good, and the difficulty of ligating the vessel high in the axilla, without injuring either the nerves or the vein, has, therefore, generally prevented the operation from being attempted. As the application of the ligature in the axilla does not make so unfavorable a wound for suppuration as the operation below the clavicle, I should prefer ligating the vessel at this point when practicable. Occasionally, fainting from loss of blood will deprive the operator of the aid to be obtained from noting the pulsation of the vessel in its full force, while the interlacing of the numerous nerves will add to his embarrassment. In one case the patient was so exhausted that I could only tell the nerves from the artery by the hollowness of the latter. In similar cases the directions just given can alone show the operator where he is; and to prove this, he should at once cease to search for the artery, and being to trace the parts methodically from the muscle backward, when he will find, as before stated, the median nerve next to the coraco-brachialis muscle, inside of it the internal cutaneous nerve, and behind this the ulnar and radial nerves. If, then, he follows the directions before given, he will find that even the ordinary amount of anatomical knowledge possessed by those long absent from the dissecting-rooms may suffice for the operation.

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* Méd. Opératoire.

forearm, and lay it over upon its back; feel for the bicipital fossa, and incise the skin for three inches in the line of the artery. On coming to the fascia, feel for the pulsation of the artery, and, carefully picking up the fascia in the forceps, lay the blade of the scalpel flat upon its side, nick the fascia, insert the director, and slit up the fascia to the extent of two and a half inches, so as to expose the inner edge of the biceps muscle, when the thick yellow sheath of the vessel will be readily seen. Incise this cautiously on its inner edge, when the median nerve—which is the first white cord on the inside of the muscle—being found, the artery may be readily exposed beneath it by tearing the connective tissue with the point of the director, when the vessel may be easily ligated from without inward by drawing the nerve a little to the outside, Plate LXVI. Fig. 2. The internal cutaneous nerve is internal to, and the ulnar nerve half an inch behind, the artery.

If, by the division of the axillary artery, high up, the brachial is deficient, the radial and ulnar arteries will be found in very much the same position as that above assigned to the brachial, the ulnar being, however, a little more to the inner and posterior side of the arm than the radial.

§ 3.—Ligation of the Brachial Artery near the Elbow.

Ordinary Operation.—Make an incision through the skin on the inner edge of the biceps muscle, or in the line from the axilla to the elbow before mentioned. Open the fascia and sheath as before directed, and the median nerve will be found about a quarter or half an inch on the *inner side* of the vessel. Separate the artery a little from its sheath with the point of the director, and apply the aneurismal needle, so that the ligature may be carried around the vessel from within outward, Plate LXVI. Fig. 2. As the median nerve passes underneath the artery, two inches above the epitrochlea, it should be remembered that, though it is on its anterior and external side at the upper part of the arm, it is here posterior and internal to it.

Remarks.—The ligation of the brachial artery at any point, is not a difficult operation to one familiar with the general relations of the median nerve to the artery; and though these vary a little, as mentioned above, the nerve is never far from the artery. The most troublesome cases are those in which the radial and ulnar arteries are given off near the axilla; but these anomalies are not very common. After the ligature is applied upon the vessel, one end should be cut off, the wound closed by adhesive strips, and the arm kept moderately warm for a few hours, until the circulation is established through the muscular and anastomosing branches. When, in ligating the artery, the arm is much swelled, the line described by Sabatier will furnish the best direction for the incision; but when it is not, the course of the biceps or coraco-brachialis muscles will suffice. The rapid enlargement of the anastomosing arteries, though soon advantageously restoring the circulation, sometimes creates trouble in cases of aneurism at the bend of the elbow, and occasionally necessitates the application of two ligatures, one above and the other below the tumor.

SECTION II.

LIGATION OF THE BRACHIAL ARTERY.

The **Brachial Artery**, in its ordinary course down the limb, may require to be ligated at any point, close attention being paid to the relations of the superficial and deep-seated veins and the nerves of the arm.

§ 1.—Anatomical Relations of the Brachial Artery.

At the lower border of the latissimus dorsi, and upon the anterior face of its insertion, the axillary artery takes the name of **Brachial**, and keeps it as far as the bend of the elbow. Throughout its length, the course of this artery is down the arm on its inner side, winding gradually forward to reach the middle of the anterior face of the bend of the elbow. At first it runs along the inner edge of the coraco-brachialis muscle; then, from its insertion, it lies upon the brachialis internus, following the inner edge of the biceps muscle, Plate LXV. Fig. 3. In the upper three-fourths of its course, it is only covered by the integuments and fascia; but at the bend of the elbow it perforates the fascia, and passes beneath the fascia-like expansion connected with the tendon of the biceps. Passing under this, it sinks deep into the middle of the bend of the arm, and divides into the radial and ulnar arteries about a finger's breadth below the joint. Two venæ satellites accompany it; the basilic vein is superficial, but runs parallel with it; and the median nerve courses along its outer side, at its upper part, between it and the coraco-brachialis muscle. Sometimes this nerve crosses the artery obliquely in front of this point, and sometimes lower down, till it gets on the ulnar side of the vessel. As a general rule, therefore, it may be said that the median nerve is at the *outer side* of the brachial artery, above; in *front* of it, at the middle; and on its *inner side*, at the lower third of the arm. The radial, ulnar, and internal cutaneous nerves are also upon its inner side, high up the arm; but lower down they advance toward the posterior and internal face of the limb, and recede from the artery. The brachial artery is liable to great varieties, sometimes giving off the radial and ulnar arteries as high up as the axilla, and being only one inch long.

§ 2.—Ligation of the Brachial Artery at the Middle of the Arm.

Lying on the inner side of the coraco-brachialis muscle, high up, and on the inner edge of the biceps muscle, lower down, the median nerve is external, or more frequently directly over or anterior to the course of the artery. Four indications point out the line of the incision: 1. The internal edge of the biceps, and, higher up, the coraco-brachialis, (Hodgson.) 2. A line drawn from the middle of the axilla to a point a little inside the middle of the bend of the elbow, (Sabatier.) 3. The ends of four fingers placed upon the median nerve, which is here on the outside of the artery, and can often be felt beneath the skin as a tense cord, the incision being made parallel with, and inside of the fingers, (Lisfranc.) 4. The pulsation of the vessel.

Ordinary Operation.—Carry the limb a little off from the body; flex the forearm, and lay it over upon its back; feel for the bicipital fossa, and incise the skin for three inches in the line of the artery. On coming to the fascia, feel for the pulsation of the artery, and, carefully picking up the fascia in the forceps, lay the blade of the scalpel flat upon its side, nick the fascia, insert the director, and slit up the fascia to the extent of two and a half inches, so as to expose the inner edge of the biceps muscle, when the thick yellow sheath of the vessel will be readily seen. Incise this cautiously on its inner edge, when the median nerve—which is the first white cord on the inside of the muscle—being found, the artery may be readily exposed beneath it by tearing the connective tissue with the point of the director, when the vessel may be easily ligated from without inward by drawing the nerve a little to the outside, Plate LXVI. Fig. 2. The internal cutaneous nerve is internal to, and the ulnar nerve half an inch behind, the artery.

If, by the division of the axillary artery, high up, the brachial is deficient, the radial and ulnar arteries will be found in very much the same position as that above assigned to the brachial, the ulnar being, however, a little more to the inner and posterior side of the arm than the radial.

§ 3.—Ligation of the Brachial Artery near the Elbow.

Ordinary Operation.—Make an incision through the skin on the inner edge of the biceps muscle, or in the line from the axilla to the elbow before mentioned. Open the fascia and sheath as before directed, and the median nerve will be found about a quarter or half an inch on the *inner side* of the vessel. Separate the artery a little from its sheath with the point of the director, and apply the aneurismal needle, so that the ligature may be carried around the vessel from within outward, Plate LXVI. Fig. 2. As the median nerve passes underneath the artery, two inches above the epitrochlea, it should be remembered that, though it is on its anterior and external side at the upper part of the arm, it is here posterior and internal to it.

Remarks.—The ligation of the brachial artery at any point, is not a difficult operation to one familiar with the general relations of the median nerve to the artery; and though these vary a little, as mentioned above, the nerve is never far from the artery. The most troublesome cases are those in which the radial and ulnar arteries are given off near the axilla; but these anomalies are not very common. After the ligature is applied upon the vessel, one end should be cut off, the wound closed by adhesive strips, and the arm kept moderately warm for a few hours, until the circulation is established through the muscular and anastomosing branches. When, in ligating the artery, the arm is much swelled, the line described by Sabatier will furnish the best direction for the incision; but when it is not, the course of the biceps or coraco-brachialis muscles will suffice. The rapid enlargement of the anastomosing arteries, though soon advantageously restoring the circulation, sometimes creates trouble in cases of aneurism at the bend of the elbow, and occasionally necessitates the application of two ligatures, one above and the other below the tumor.

PLATE LXVI.

LIGATION OF THE ARTERIES OF THE UPPER EXTREMITY.

Fig. 1. Surgical Anatomy of the Blood-vessels of the Forearm and Hand. 1. Brachial artery. 2. Radial artery. 3. Ulnar artery. 4. Position of the radial artery at the wrist. 5. Position of the ulnar at the wrist. 6. Palmar arch. 7. Radialis indicis. 8. Basilic vein. 9. The cephalic vein. 10. Venæ satellites of the radial artery. 11. Venæ satellites of the ulnar artery. 12. Median nerve. 13. Radial nerve. 14. Ulnar nerve. 15. Biceps tendon. 16. The supinator radii longus. 17. The flexor carpi radialis. 18. Flexor carpi ulnaris tendon. *After Bernard and Huette.*

Fig. 2. Ligation of the Brachial Artery. *Upper Incision.*—1. The skin. 2. The fascia. 3. The brachial vein. 4. The median nerve. 5. The artery on a director.

Second Incision near the Elbow.—1. Skin. 2. Fascia. 3. Inner edge of biceps. 4. Median nerve. 5. The artery on director.

After Bernard and Huette.

Fig. 3. Ligation of the Radial and Ulnar Arteries. *Upper Third.*—1. The skin. 2. The fascia. 3. The radial artery. 4. The radial nerve. 5. The director under the artery. 6. Inner edge of the supinator radii longus. *At Wrist.*—1. Skin. 2. Fascia. 3. Artery on director. 4. Radial nerve. *Ligation of the Ulnar Artery at the Middle of the Forearm.*—1. Skin. 2. Fascia. 3. Artery. 4 Vein. *Ligation of the Ulnar Artery at the Wrist.*—1. Skin. 2. Fascia. 3. Artery on director. 4. Nerve. *After Bernard and Huette.*

Fig. 4. Anatomical Relations of the Arteria Dorsalis Pedis. 1. The anterior tibial artery. 2. The anterior tibial nerve. 3. The anterior annular ligament. 4. The tendon of the extensor proprius pollicis. 5. The extensor brevis digitorum pedis. *After Bernard and Huette.*

Fig. 5. Ligation of the Anterior Tibial Artery on the Foot. 1. Skin. 2. Fascia. 3. Director. 4. Artery raised on it. *After Bernard and Huette.*

Plate [illegible]

Fig. 2

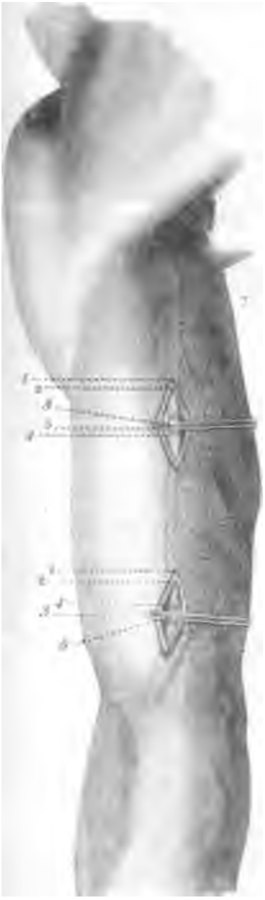


Fig. 3

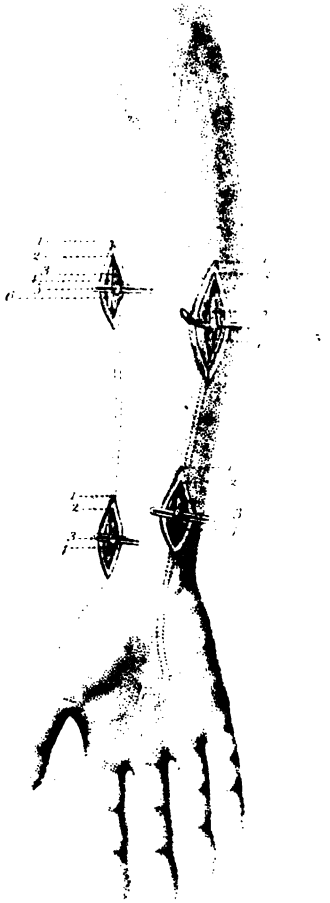


Fig. 1.

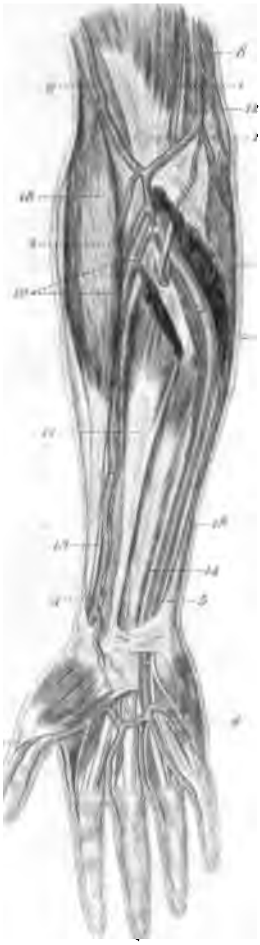


Fig. 4

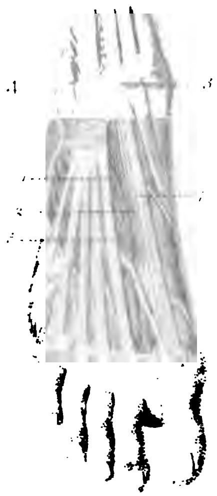


Fig. 5

SECTION III.

LIGATION OF THE RADIAL ARTERY.

The **Radial Artery** is seldom ligated, except at the points hereafter mentioned, owing to its muscular relations.

§ 1.—Anatomical Relations of the Radial Artery.

At the upper third of the forearm, the **Radial Artery** is placed in the groove that separates the supinator radii longus from the pronator radii teres and flexor carpi radialis muscles, where it is covered by the inner edge of the supinator muscle, by the fascia, and by the skin. The radial nerve is on its outside, and the venæ satellites accompanying it as usual, Plate LXVI. Fig. 1.

At the lower third of the forearm, the artery is only covered by the skin and fascia; has the tendon of the flexor carpi radialis on its inner side, and the radial nerve far outside of it.

When the limb is too much swollen to permit the distinguishing of these marks of reference, a line drawn from a point half an inch outside of the middle of the front of the elbow to a point on the outer side of the forearm, two inches and a half below, would indicate its course above, (Lisfranc,) or from a similar point at the elbow to the middle of the space which separates the styloid process of the radius from the tendon of the flexor carpi radialis, (Malgaigne,) would show its position below.

§ 2.—Ligation of the Radial Artery.

The **Radial Artery** may be tied either at its upper or at its lower third.

I. **Ordinary Operation at the Upper Third of the Forearm.**—The ligation of the radial artery at its upper third may be readily accomplished by an incision in the line just described, which it takes from the elbow to the hand. In doing this, the skin should be divided to the extent of two and a half or three inches, the median vein pushed to one side, the supinator muscle exposed by laying open the fascia, and then its internal border raised with the finger or director, when the sheath of the vessels may be seen and opened, Plate LXVI. Fig. 3. As the artery passes in the depression that exists between the supinator radii longus and the pronator radii teres and flexor carpi radialis muscles covered by the inner edge of the supinator, it is important carefully to incise the fascia, and then press the finger between the muscles so as not to separate the fibres of either muscle, but so as to fall into the intermuscular space. If the artery is not readily met with, draw the muscle outward until the radial nerve is seen, which is never absent; and seeking between this nerve and the median line of the arm, the artery will surely be found, unless there is an anomaly.

II. **Ligation of the Radial at the Wrist.**—Make an incision two inches long, parallel with and on the radial side of the tendon of the flexor carpi radialis about half an inch from the wrist-joint, pick up the fascia in the forceps, nick it cautiously, and open it upon a director, when the artery will be found on the outer or radial side of the tendon, Plate LXVI. Fig. 3.

Remarks.—The ligation of the radial artery at the points mentioned may

II. **Ligation of the Ulnar Artery above the Wrist.—Ordinary Operation.**—Make an incision two inches long, and one inch above the joint, parallel with the tendon of the flexor carpi ulnaris; pick up the fascia, divide it, draw the tendon a little *inward*, and the artery will be found on its *external* or *radial* side beneath the deep fascia, the ulnar nerve being on its inside and posteriorly. Open this deep fascia, and pass the ligature from within outward, Plate LXVI. Fig. 3.

Remarks.—The ligation of the ulnar artery at its upper third is now never attempted, on account of the difficulty of finding the vessel, as well as the subsequent free suppuration of the wound. It is also better to avoid, if possible, ligating this vessel in its middle third, for the same reason; the ligation near the wrist being usually sufficient for wounds of the palmar arch, as it is generally these cases which most frequently demand the operation.

CHAPTER III.

LIGATION OF THE ARTERIES OF THE LOWER EXTREMITY.

The main artery supplying the lower extremity being the continuation of the external iliac, it is at different points named **Femoral** and **Popliteal,** according to its position. It may be ligated at any portion of its course.

SECTION I.

LIGATION OF THE FEMORAL ARTERY.

§ 1.—Anatomical Relations of the Femoral Artery.

The line of the groin, or that caused by the attachment of Poupart's ligament to the bones of the pelvis, constituting the upper boundary of the **Femoral Artery,** the vessel continues under this name throughout its entire course, until it passes through the insertion of the adductor muscle, at a point which is about one-third of the whole length of the femur, above the knee-joint, when it takes the name of **Popliteal Artery.** In the space thus described, the femoral artery runs a winding course, being first on the anterior, then on the inner side, and lastly near the posterior face of the thigh, following thus the direction of a line drawn from the middle of the crural arch to the posterior and internal part of the condyle of the femur, or the course of the sartorius muscle. It is inclosed in a common sheath with the femoral vein, the latter being on its inner or pubic side near the groin, behind it in the middle of the thigh, and a little to its outer side, below the middle third, Plate LXVII. Fig. 1.

The anterior crural nerve lies upon the external side of the artery outside the sheath of the vessels, while the long saphenous nerve enters the upper fourth of the sheath, and lies upon the outer side of the artery, Plate LXVII. Fig. 1. At its upper fourth, the artery is only covered by the skin and fascia, and may be easily compressed against the bones of the pel-

PLATE LXVII.

LIGATION OF THE ARTERIES OF THE LOWER EXTREMITY.

Fig. 1. Anatomy of the Femoral Vessels. 1, 1. The femoral artery. 2, 2. The femoral vein. 3. The internal saphena vein. 4 Muscular branch of the artery. 5. The long saphenous nerve. 6. The branch in front of the sheath of the vessels. 7. Arteria profunda. 8. Opening in the adductor muscle. 9. The musculo-cutaneous nerves. 10. The anterior crural nerve. 11, 11. Hooks holding aside the sartorius muscle. *After Bernard and Huette.*

Fig. 2. Ligation of the Femoral Artery. *At its Upper Third.*—1. The skin. 2. The fascia. 3. The sheath of the vessels. 4. The artery raised on the director. 5. The femoral vein. 6. The long saphenous nerve. 7. The inner edge of the sartorius muscle. *At its Lower Third.*—1. The skin. 2. The fascia 3. The external edge of the sartorius muscle. 4. The femoral vein. 5. The long saphenous nerve. 6. The artery exposed in its sheath.
After Bernard and Huette.

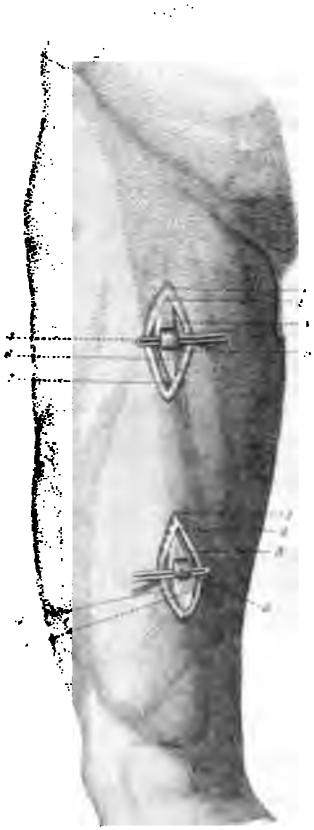
Fig. 3. Anatomy of the Popliteal Artery. 1. The artery. 2. The vein. 3. The semi-membranosus muscle. 4. The gastrocnemius. 5, 5. Hooks holding aside the muscles. *After Bernard and Huette.*

Fig. 4. The course and relations of the Popliteal Artery to the Joint. 1, 1. The artery. 2. The femur. 3. The tibia. 4, 4. The posterior face of the knee-joint. 5, 6, 7. The articulating arteries. *After Bernard and Huette.*

Fig. 5. Ligation of the Popliteal Artery in its *Upper Half.* 1. The skin. 2 The fascia. 3. The fat. 4. The peroneal nerve. 5. The external saphena vein. 6. The popliteal vein. 7. The artery as shown by 8 the hook holding aside the veins. *After Bernard and Huette.*

Fig. 6. Ligation of the Posterior Tibial Artery. *At its Upper Third.*—1. The skin. 2. The fascia. 3, 3. The gastrocnemius muscle held aside by a blunt hook. 4. The artery on the needle. 5. The soleus muscle. *At its Middle Third.*—1. The skin. 2. The fascia. 3. The external edge of soleus. 4. The artery. 5. The needle under it. 6. The posterior tibial nerve. *At the Ankle.*—1. The skin. 2. The director under the artery. 3. The posterior tibial nerve. *After Bernard and Huette*

Plate 67



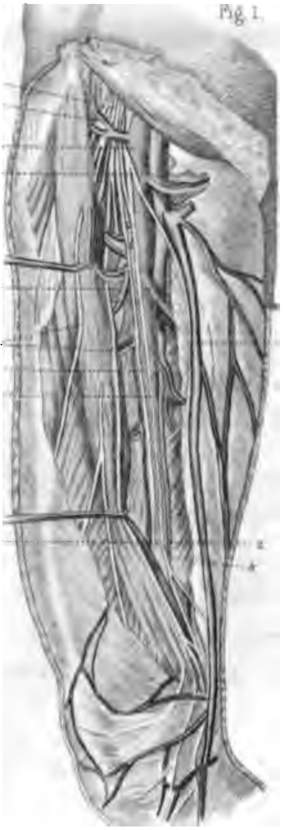
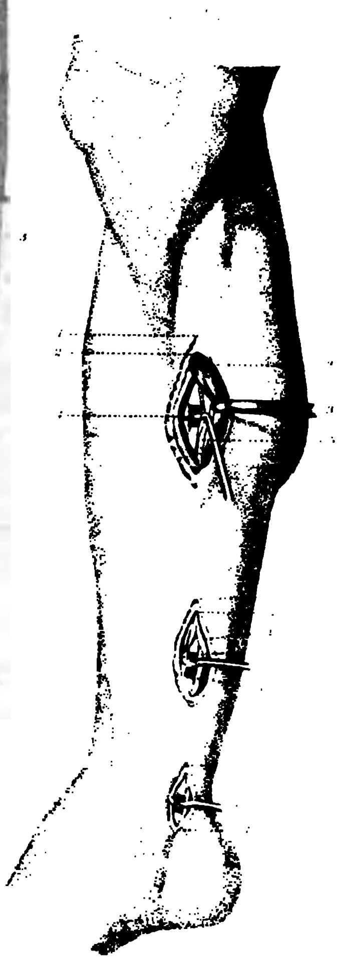
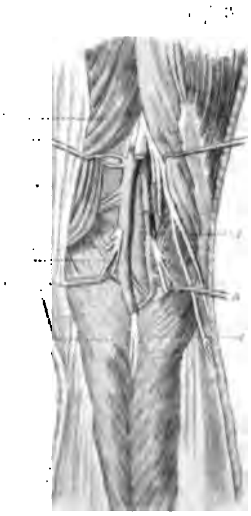
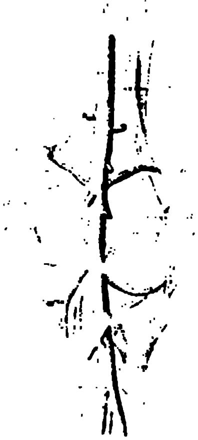
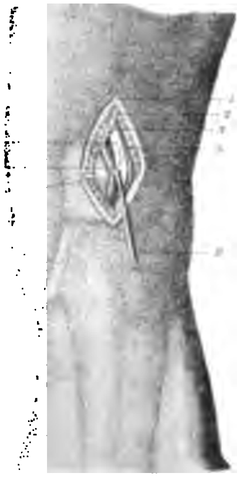


Fig. 1.









vis; but below it is crossed obliquely by the sartorius muscle, so that at the upper part of the thigh this muscle is on the outer side of the artery, covers it in its middle, and leaves the artery on its outer side low down the thigh. The regular course of this muscle makes it a most useful point of reference when attention is given to its relations at the different points of the limb.

Mott, of New York, whose experience in the ligation of this artery has been very great, thinks it advisable to study the relations of the vessel at the three points in which it may be ligated—thus: 1st, at Scarpa's triangle, or the space bounded above by Poupart's ligament, outside by the sartorius, and inside by the adductor longus muscles; 2d, where it is covered by the sartorius muscle; and 3d, near the opening made for its passage through the adductor magnus muscle.*

§ 2.—Ligation of the Femoral Artery.

The **Femoral Artery** may be tied either at its inferior, middle, or superior portions; the first two points being those most commonly resorted to, though it has been occasionally tied at its upper end. In all cases it is important after the operation to preserve the warmth of the limb by artificial heat until the circulation is restored.

I. Ligation of the Femoral Artery at the Upper Part of the Thigh.—Scarpa's Operation.—At Scarpa's triangle the artery is quite superficial, and may be readily felt pulsating in the triangular space formed by the junction of the sartorius, adductor longus, and Poupart's ligament, the base of the triangle being above or at the groin, and its apex below. The most favorable point, according to Hodgson, for the application of a ligature, is about four or five inches below the crural arch, because it gives room for the formation of a coagulum above the origin of the profunda. The operation should be performed as follows:—

Operation.—Feel for the pulsation of the artery, and note the spot where it is faintest, which will indicate the point where the vessel is crossed by the sartorius muscle, and commencing at this part incise the skin obliquely downward to the extent of three inches, taking care to push the saphena vein inward. On exposing the fascia lata, pick up a fold at the lower point of the incision; nick it, introduce a director, and slit the fascia up to the same extent as the skin; open the sheath in the same manner, and expose the artery with the point of the director, the nerve being on its outside, and the vein still at its inner side, and tie the artery by passing the needle from within outward, so as to avoid the vein.

II. Ligation of the Femoral Artery in the Middle of the Thigh.—Operation of Hunter.—Flex the thigh on the pelvis, and the leg on the thigh, and lay the latter upon its outer face, so as to relax the muscles. Then, feeling for the inner edge of the sartorius muscle, make an incision three inches long, so that its lower end shall be about two lines from the inner edge of the muscle, and its upper about four, but without dividing the saphena vein. After incising the skin and fat, pick up the fascia in the forceps, nick it, introduce a director, and slit it up to the extent of the incision in the skin, so as to expose the internal border of the sartorius muscle, which may be recognized by the course of its fibres. Then carefully opening the sheath of the vessels, which here appears as a thick yellowish structure, incise it slightly upon a director, separate the vein from the inner side of the artery with the point of the director, and pass the aneurismal needle from

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* New York Register, vol. i. p. 185.

within outward, Plate LXVII. Fig. 2. If the needle is passed in the opposite direction, its point may wound the vein, and the escape of even a little blood will materially interfere with the sight of the surgeon and delay the operation.

Operation of Mott.*—In the operations upon the femoral artery, Mott advises the surgeon always to open the sheath of the vessels in front, and never to use the edge of the knife near the sides of the artery, or within its sheath, lest he wound some of the branches which generally are given off from its sides.

Remarks.—The œdematous condition of the thigh, sometimes seen in cases demanding the ligation of the femoral artery, adds materially to the difficulties attending this operation when required upon the patient. As above described, these methods are chiefly adapted to the dissecting-room, or to the natural condition of the parts. When, therefore, any difficulty is experienced in recognizing the muscular spaces in the middle of the thigh, a line drawn from the middle of the groin, as directed, will prove of great service. Occasionally, the Femoral artery has been tied close to the crural arch, where its position can be readily recognized as being half way between the spine of the pubis and the anterior superior spinous process of the ilium in man, though a little nearer to the pubis in woman; but this operation is not so favorable as that lower down, as it exposes the patient to greater risks from the occurrence of gangrene, the origin of the profunda favoring the course of the circulation when the ligature is applied in the middle of the thigh. The ligation of the femoral artery, as practiced in the lower third of the thigh, is shown in Plate LXVII. Fig. 2; but as it requires the division of the arterial canal through the adductor magnus, and also makes a deep wound, it is seldom resorted to on the patient.

SECTION II.

LIGATION OF THE POPLITEAL ARTERY.

§ 1.—Anatomical Relations of the Popliteal Artery.

The **Popliteal Artery** being a continuation of the femoral, extends from the insertion of the adductor magnus tendon to the inferior margin of the popliteus muscle, being covered by the vein which is between it and the skin, and somewhat internal to it above, but external below. The belly of the semimembranosus and the two heads of the gastrocnemius muscles also cover it. The artery is first on the inner side of the femur, then approaches its posterior face, and, passing between the condyles, is in contact with the back of the knee-joint.

§ 2.—Ligation of the Popliteal Artery.

When the application of a ligature to this artery is deemed advisable, it may be accomplished by the method hereafter mentioned. But in aneurisms of this vessel its ligation would be very difficult, if not impossible, and compression had better be applied to the Femoral artery in the thigh, in accordance with the principles before stated,† or the ligature applied in the middle of the thigh.

Lisfranc's Operation.—The patient being laid upon his face, with the limb extended, feel for the interval between the two heads of the gastrocnemius muscle, and make in this line a longitudinal incision three inches long, commencing at one-third of an inch below the joint and a little outside of the median line. Then, pushing aside the external saphena vein, pick up the fascia, nick it, introduce a director, and incise it to the extent of the opening in the skin; flex the leg on the thigh, and feel for the space between the two heads of the gastrocnemius, at the bottom of which the vessels and nerves will be found. Of these, the popliteal nerve is first seen, and on the inside of it is the vein, the artery being on the outside in the majority of cases, when it only remains to draw the nerve and vein inward, and pass the needle under the artery from within outward,* Plate LXVII. Fig. 5.

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* New York Register, vol. i. p. 186.

† Vol. i. p. 797.

Remarks.—The ligation of the popliteal artery, as above described, is an operation that is seldom or never undertaken, except in rare cases of wounds exposing the vessel, the depth at which the artery is placed, its proximity to the joint, and the liability of the latter to inflame, as well as the risk arising from the suppuration traveling beneath the fascia of the leg, inducing surgeons to avoid it. In all cases of aneurism, or wounds of the tibial arteries high up, it is easier and safer to tie the femoral at the middle of the thigh; and in the case of aneurism of the popliteal itself, the position of the tumor, as just stated, would render it absolutely necessary to place the ligature higher up. The operation is one, therefore, which is seldom practiced except in the dissecting-room. Lord, of Portland, Maine, succeeded, in 1855, in ligating it in a case of wound from a chisel. The majority of surgeons would probably prefer to tie the femoral, unless in similar cases of wounds of this region directly opening the vessel.

SECTION III.

LIGATION OF THE POSTERIOR TIBIAL ARTERY.

§ 1.—Anatomical Relations of the Posterior Tibial Artery.

The **Posterior Tibial Artery** arises from the popliteal, and terminates beneath the internal annular ligament of the ankle, where it gives off the two plantar arteries. Its course is indicated by a line drawn from the middle of the ham to a point half way between the internal malleolus and the tendo-Achillis. At its upper third it lies very deep, being beneath the tibialis posticus, and being also covered by the deep fascia and the muscles of the calf. In its middle third it is more superficial, and passes along parallel with the inner side of the tibia, from which it is separated by the flexor longus digitorum pedis, though it is also covered by the deep fascia and internal margin of the soleus, Plate LXVIII. Fig. 4.

At its lower third, it is immediately beneath the fascia, passes posteriorly the tendons of the tibialis posticus and flexor longus digitorum pedis, and is almost parallel with the posterior margin of the malleolus internus. It may be ligated at its upper, middle, or lower third.

§ 2.—Ligation of the Posterior Tibial Artery.

The **Ligation of the Posterior Tibial Artery** may be accomplished, as stated, at any part of its course, but is seldom attempted except in its middle

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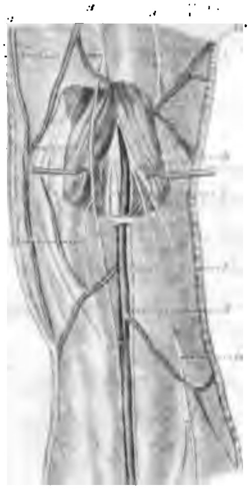
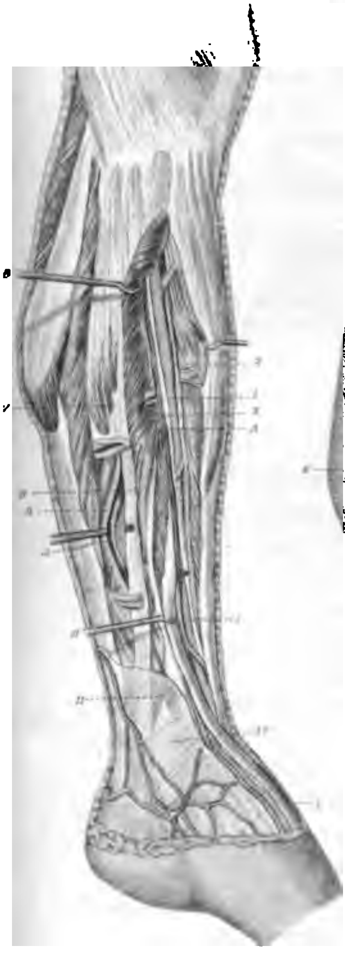
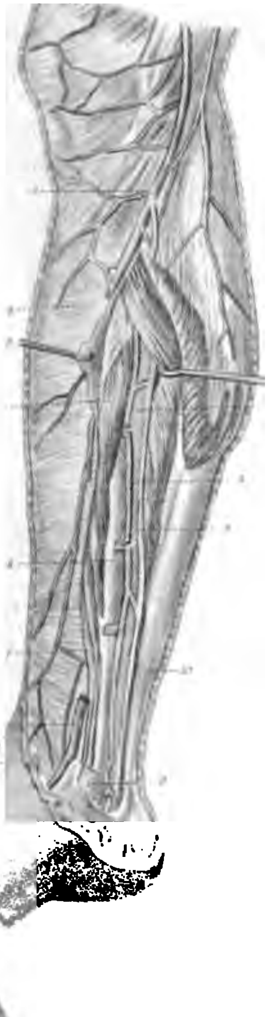
* Malgaigne.







and lower third. Should it be desired to tie it above, the surgeon should be careful not to lose sight of its muscular relations, as an error in separating the proper muscles, as hereafter detailed, will probably cause the failure of the operation.

I. **Operation at its Upper Third.—Malgaigne's Operation.**—Make an incision at least four inches long, entirely through the skin, connective tissue, and fascia, commencing about half an inch from the inner margin of the tibia; introduce the forefinger, and detach and carry outward the internal head of the gastrocnemius as well as the soleus. Then, while an assistant holds these muscles backward and outward, open the deep fascia upon a director, and look for the artery; on finding it, separate it from its accompanying veins, and ligate it, Plate LXVII. Fig. 6.

Remarks.—This operation is an exceedingly troublesome one, in consequence of the depth of the incision and the contraction of the muscles. A trial upon the subject will soon satisfy any one of the difficulties to be encountered in the patient. It is, therefore, rarely resorted to.

II. **Ligation of the Posterior Tibial Artery at its Middle Third.—Ordinary Operation.**—Make an incision two and a half inches long and three-quarters of an inch from the internal edge of the tibia, as advised by Manec, and, cutting through the skin and fat, pick up the superficial fascia, nick it, introduce the director, and slit it up. Then push the soleus muscle upward and outward, so as to expose the deep fascia, or that which forms the posterior sheath of the muscle, divide it on the director, and, separating the artery from its venæ satellites, carry the ligature around it either from without inward or the reverse. The posterior tibial nerve lies upon the *outer side* of the artery at this part of the leg, and is a good point of reference.

Velpeau's Operation.*—Make a straight incision, about three inches long, at an equal distance between the inner margin of the tibia and the tendo-Achillis, so as to divide the skin and fat; pick up the fascia, nick it, introduce a director, and slit it up to the same distance. Denude the deep fascia by separating the fibres of the muscle with the point of the director; incise it to the same extent as the skin; separate the artery, and tie it, Plate LXVII. Fig. 6.

III **Ligation of the Posterior Tibial Artery behind the Malleolus Internus.—Lisfranc's Operation.**—Make a longitudinal or a semicircular incision in the skin parallel with the internal malleolus, but two lines posterior to it, extending half an inch below and one inch and a quarter above it; pick up the fascia, and divide it carefully upon a director, when the artery will be fully exposed, accompanied by its venæ satellites. The posterior tibial nerve lies posteriorly and externally to the artery, Plate LXVII. Fig. 6.

Remarks.—The ligation of the posterior tibial artery near the malleolus is a simple operation, and one that is well adapted to the treatment of wounds of the plantar arteries. Velpeau prefers that the incision should be made at least half an inch behind the internal malleolus, and Manec, that it should be half way between the tendo-Achillis and the malleolus. Of these methods I prefer the incision of Lisfranc, as its line will enable the operator to search to either side of it if he fails to fall upon the artery. As the vessel lies beneath the deep fascia, two layers must be divided after the skin, in order to expose it. The nerve, which is of some size, lies upon its outer or posterior side. The artery may also be found by seeking first the tendons of the tibialis posticus and flexor longus pollicis pedis, in their groove behind the sinuosity of the os calcis, and, finding them, the artery will be seen beneat and posterior to them, or between these tendons and the tendo-Achillis.

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* Operat. Surgery, by Mott and Townsend, vol. ii. p. 127.

The operation in the middle of the leg, as previously described, is somewhat more difficult, owing to the depth at which the artery is placed.

SECTION IV.

LIGATION OF THE ANTERIOR TIBIAL ARTERY.

§ 1.—Anatomical Relations of the Anterior Tibial Artery.

The **Anterior Tibial Artery**, after passing through the interosseous ligament in the upper part of the leg, lies upon the interosseous ligament in th upper two-thirds of the leg, but is upon the anterior face of the tibia below till it gets upon the dorsum of the foot, where it terminates by dipping int the first metatarsal interosseous space to anastomose with the branches o the plantar arch, Plate LXVIII. Fig. 5. In its course on the leg, it follows a line which is drawn from the middle of the space between the head o the fibula and the spine of the tibia to the middle of the intermalleolar space and from this space to the middle of the first metatarsal interosseous spac of the foot. The anterior tibial nerve is successively seen on the outer sid of the artery above, in front of it in the middle of the leg, and inside of i below, though throughout its entire course it is very close to the artery Owing to its depth, the anterior tibial artery is seldom tied high up, though this may be accomplished, while, in consequence of the proximity of th ankle-joint, it is seldom tied near the joint. The most common points are therefore, its middle third and that on the dorsum of the foot.

§ 2.—Operations for the Ligation of the Anterior Tibial Artery.

I. Ligation of the Anterior Tibial at its Middle Third.—Ordinary Operation.—The patient lying, or sitting with the leg extended, move th foot, so as to cause the tendon of the tibialis anticus to become prominent, and, following the course of the tendon when it can be felt, or the line above described when it cannot, make an incision three inches long through the skin and fascia; open the fascia freely, and seek for the first tendon, or the first intermuscular space from the spine of the tibia. When difficulty occurs in finding the intermuscular space, lay bare the tibialis anticus muscle, and, pressing the forefinger from the spine of the tibia outward, the belly of the muscle will roll upward and the finger sink into the space between it and the extensor proprius pollicis. Separate the muscles at this point with the finger or director; flex the foot; hold back the muscles at the side of the wound with blunt hooks, and the artery will be seen at the bottom of the space, with the anterior tibial nerve crossing it at this point of the limb, though it is on the inner side of the vessel lower down. Pass the needle from the fibula toward the tibia, and from below upward, and apply the ligature, Plate LXVIII. Fig. 6. Should the operator carry the incision too far outward, the second intermuscular space may be found, and mislead him; to remedy which it is better, in case of doubt, to feel from the spine of the tibia outward, and the error will soon be indicated.

II. Ligation of the Anterior Tibial on the Dorsum of the Foot, sometimes called the Pedal Artery.—Ordinary Operation.—Draw a line from the middle of the space between the two malleoli to the first metatarsal interosseous space, and make an incision through the skin along the *external* border of the tendon of the extensor proprius pollicis pedis, but parallel to it, or between it and the first fasciculus of the tendons of the extensor communis, which may be made prominent by causing the patient to extend his toes. After which, the sheath of the extensor communis, or the deep fascia, should be incised and opened upon a director, when the artery, with its two veins, will be clearly seen. The branch of the nerve lies to its inner side, Plate LXVI. Fig. 4.

Remarks.—This operation is very simple, and may be performed in less time than it takes to describe it, as a little practice upon the subject will soon prove, the most common mistake being the disposition to look for the vessel on the inner, instead of the outer side of the tendon of the extensor proprius pollicis. The *first fasciculus* of the *extensor communis tendon* is, therefore, a better point of reference. The operation on this vessel may be required in the treatment of aneurism or for wounds, though most frequently pressure suffices for the latter. The spica bandage of the instep will be the proper dressing after the operation. In operating for the cure of aneurism of this artery, it will be safer to place a ligature above and one below the tumor, in order to prevent recurrent hemorrhage.

CHAPTER IV.

OPERATIONS ON THE BONES OF THE UPPER EXTREMITY.

The operations performed for the relief of the affections of the bones of the upper extremity do not differ from those practiced in the lower limbs, except in the slight modifications rendered necessary by their relations to surrounding parts. Certain general rules are, therefore, applicable to both extremities, and such additional remarks as are required beyond what were made in connection with the resection of the clavicle,* will be given hereafter, the special operative proceedings being detailed in connection with the extremity to which they belong.

SECTION I.

RESECTIONS IN GENERAL.

By **Resection of the Bones of the Extremities,** as has been before stated, is usually meant such an operation as removes a sufficient portion of their structure to create a void or solution of continuity, but yet retains the limb, and subsequently permits a considerable degree of motion in it. In many instances, though resection of these bones results in more or less shortening, even then the member will prove to be much more serviceable than an artificial limb; and the operation is, therefore, one which enables the surgeon to remove the disease, and yet not destroy the usefulness of the extremity.

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* Vol. ii. p. 334.

The advantages of resection over amputation in disorders limited to the articulations is therefore very apparent. In amputation, the entire member is often removed in consequence of a disorder which is comparatively limited, as in caries of the shoulder, or of the hip or knee-joint; whereas by a resection the diseased part is alone extirpated, the sound portions of the limb being left to perform their functions. For these reasons, the experience of surgeons is now gradually establishing the superiority of this operation over amputation, and the propriety of attempting the relief of diseases of the joints, by means of a resection of the articulation, should therefore be always thought of before resorting to any other. A looseness of expression has, however, led some surgeons to describe as resections operations which are really amputations. When, therefore, in any case, a bone is removed with the limb, the operation can only be regarded as an amputation, and not as a resection, the utility and chief characteristics of the latter class of operations consisting in the preservation of the motion of the extremity.

The general conditions which are essential for the proper performance of a resection may be divided into such as concern the patient, and such as pertain to the surgeon.

On the part of the patient it is essential that the disorder, whether caries, necrosis, exostosis, or other bony tumor, should be limited in its extent, so that the surgeon may be certain of removing the entire complaint. The surrounding soft parts should also be in a condition favorable to the healing of the wound, without being liable to such contraction, suppuration, or ulceration as may subsequently impair the motion of the limb, the function of which should always be preserved after the operation, if only in a modified form.

The surgeon, in addition to the ordinary attributes of an operator, such as coolness and dexterity, should have an accurate knowledge of the relations of the adjoining structures, as the various muscles, tendons, nerves, and blood-vessels in the neighborhood must all be left untouched, if possible. Especially is it important to avoid unnecessary injury to the periosteum, as through this membrane the new structure will often be replaced in such a manner as to add much to the usefulness of the limb, as has been already stated in connection with the subject of Callus in Fractures.

As the resection of the bones of the extremities is also very liable to induce severe constitutional disturbance, and to give rise to fever, erysipelas, or long-continued suppuration, much medical skill will be necessary to conduct the case to a favorable termination; it being essential to success that the after-treatment of the case be judiciously directed, the diet and internal as well as local remedies being carefully superintended by the operator.

For the performance of any resection, various saws, chisels, gouges, bone-nippers, etc. will be required, together with proper means for accomplishing the division of the soft parts, arresting hemorrhage, and dressing the wound. As the number of instruments resorted to in operations upon the bones is nearly indefinite, the reader is simply referred to Plate V. for a view of such as are most frequently wanted.

Scooping of Bone, and Preservation of Periosteum.—Since the influence of the periosteum in producing bone has been strengthened by the results pointed out by Flourens and others, and it has been shown by Ollier that bone will be formed even by portions of periosteum everted, transplanted, etc., surgeons have given their attention to such operative proceedings as were particularly calculated to preserve this important membrane as far as possible, or to prevent its unnecessary displacement in resections. In these operations especially, as demanded for caries, Sedillot, of Strasbourg, has warmly, and, we think, very correctly, advocated leaving the compact matter of a bone wherever practicable, and scooping out only the affected portion.

Of thirteen cases reported to the Academy of Medicine of Paris, ten recovered and three died, including that of a young girl, the lower part of whose femur, with the condyles, was scooped out and cured, so that she walked well; while a man, in whom the whole articulating surface and inside of the malleolus of the tibia was removed, was able eventually to walk many miles.

Verneuil, of Paris, has likewise shown to the Academy of Paris that by dissecting very carefully whatever periosteum is left in disease of the elbow-joint the result is very satisfactory. In caries of the tarsal bones, the author has also had very good results, preserving a useful foot by scooping out all the bone, except a thin shell.

SECTION II.

RESECTION OF THE BONES OF THE UPPER EXTREMITIES.

The **Resection of the Bones of the Upper Extremities** may be practiced either upon their diaphyses or upon their articulating extremities. In operating upon the diaphysis, a free external incision is necessary in order that the entire removal of the diseased structure by saws, chisels, and gouges may be accomplished without creating a fracture.

As resection of the scapula and clavicle has been before referred to, in connection with the operations on the chest, it only remains to describe the operations practiced on the upper limb, from the glenoid cavity down to the fingers.

§ 1.—Resection of the Shoulder-Joint.

The **Head of the Humerus** and the articulating surfaces of the scapula may, from caries, necrosis, or other complaints, demand resection, so as to free the patient from a source of irritation which might otherwise exhaust the powers of life; and may be accomplished by exposing the articulation, and removing the diseased portion by means of the saw or gouge.

Operation of White, of England.—Make an incision down to the bone parallel with the fibres of the deltoid muscles, and extending from the apex of the acromion four or five inches downward, so as to open the capsule on the outer side of the joint; then carry the elbow in toward the body; luxate the head of the bone through the muscle, and saw it off.

Syme's Operation.—While an assistant compresses the subclavian artery, make a longitudinal incision, three and a half inches long, in the middle of the deltoid muscle, and a shorter one from its inferior extremity upward and backward, toward the posterior border of the axilla, so as to form a triangular flap. Raise it up, and while it is held by the assistant, carry the elbow in toward the side of the body, so as to render the capsular ligament tense. Open it by a circular incision around the head of the bone, luxate it, slip a piece of binders' board under it, and saw it off with the amputating saw. Then cleanse the wound, Plate LXIX. Fig. 1, bring down the flap, and attach its point to the skin of the arm by a single stitch of the interrupted suture, taking care to insure a vent for any pus that may accumulate; after which it only remains to apply the starch bandage and spica of the shoulder, so as to leave the wound open.

Lisfranc's Operation.—In this operation, a posterior flap is formed similar to that hereafter directed in the account of his amputation of the shoulder,

PLATE LXIX.

RESECTION OF THE BONES OF THE UPPER EXTREMITY.

Fig. 1. Syme's Operation for Resection of the Head of the Humerus. The patient being seated, an assistant compresses the subclavian artery with 1, his right forefinger, while with 2, the fingers of his left hand, he holds up the triangular flap. As the operation is just completed, 4 shows the glenoid cavity, and 5 the section of the humerus. *After Bourgery and Jacob.*

Fig. 2. Bourgery's Operation for Resection of the Head of the Humerus. The arm being carried off from the body by 2, the left hand of the surgeon, the subclavian artery is compressed by one assistant, while the surgeon transfixes the soft parts near the end of the bone by a catlin, and cuts downward, parallel with the humerus, to the length of three inches. Another assistant then passes 1, 1, a piece of bandage, through the wound and around the bone above and below, so as to protect the soft parts. The head of the bone being now isolated, it is sawed off by the chain-saw. *After Bourgery and Jacob.*

Fig. 3. Moreau's Operation for Resection of the Elbow-Joint. 1. Hand of assistant reverting the quadrilateral flap. 2. Condyles of humerus. 3. Strip beneath the bone to protect the soft parts from the action of 4, the saw. *After Bernard and Huette.*

Fig. 4. The same operation concluded. 1, 2, 3, 4. The quadrilateral flap replaced and held in position by the sutures. *After Bernard and Huette.*

Fig. 5. Resection of the Radius. 1, 2. The incision. 3. Hand of the surgeon, disarticulating the bone. 4. The knife. 5. The inferior end of the radius. 6. Its superior portion. This operation should have been represented as the extirpation of the ulna, which has been accomplished by Butt, of Virginia, in a similar matter. *After Bernard and Huette.*

Fig. 6. Resection of the Lower End of the Ulna. 1. Triangular flap turned back. 2. The articulating surface of the bone. 3. A strip passed beneath the bone to protect the soft parts from 4, the saw. *After Bernard and Huette.*

Fig. 7. Velpeau's Operation for Resection of the carpal surface of the Radius and Ulna. 1, 1. The vertical incision. 2, 3. The transverse cut. This transverse incision is incorrectly represented, as it should have been carried across from 1, 1, so as to revert the flap downward. *After Bernard and Huette.*

Plate 69.

Fig. 1.

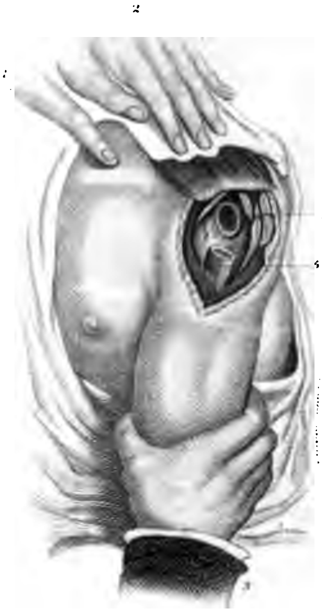


Fig. 2.

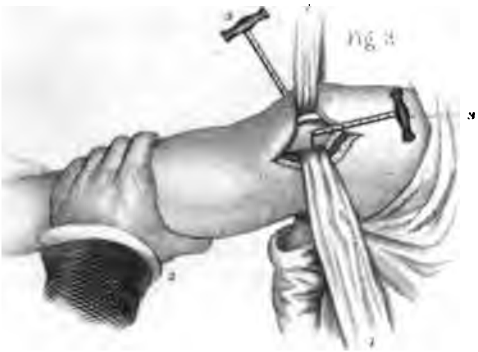


Fig. 4.

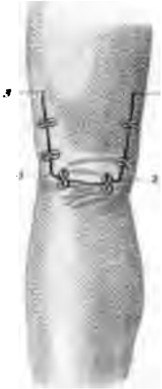


Fig. 3.

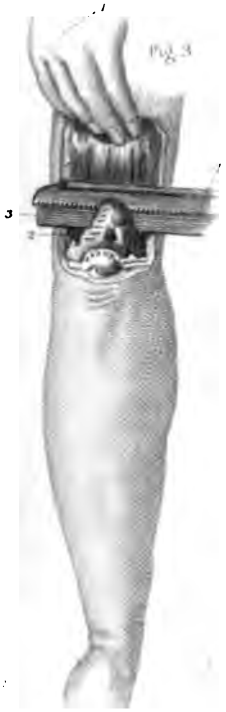


Fig. 5.

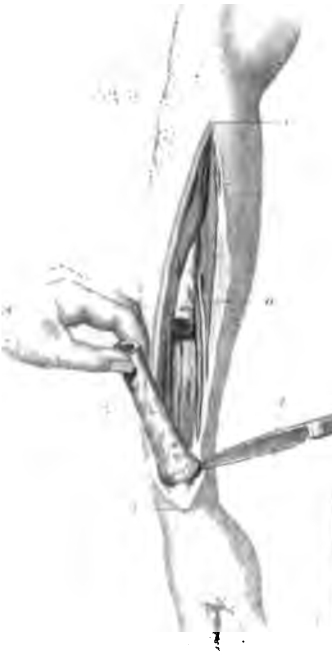


Fig. 6.

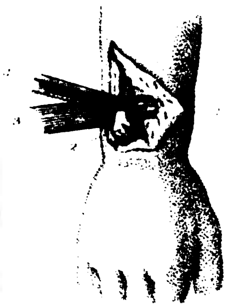
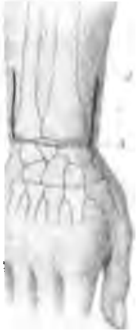


Fig. 7.



the head of the bone being luxated, sawed off, and treated as before directed.

Remarks.—Resection of the head of the humerus is an operation that has been repeatedly performed with success in cases of caries of the head of the bone, as well as of the glenoid cavity, the removal of the latter being readily accomplished by the bone-nippers, after the articulation is exposed. As a means of saving the patient the partial use of an important member, which in former times would have been amputated, this operation must be regarded as one of the most useful of those suggested within the last century. Although the scapula and end of the humerus are no longer in contact after the performance of this resection, a considerable amount of motion will yet be preserved at the shoulder, and in a case reported by Syme the use of the arm was almost completely established.

Resection of the head of the humerus has been frequently performed by surgeons in the United States, being cases reported by Hunt, of Washington,* and one of a partial character by Pinkney, U. S. Navy.† Since the war, many others have been performed with satisfactory results. In selecting a method, that of White should be preferred, if the induration and other injury to the soft parts do not forbid it, as it preserves the more perfect action of the deltoid, and thus facilitates the subsequent motion of the shoulder; but the section of the deltoid, as advised by Syme and Lisfranc, exposes the joint more freely, and is better adapted to such cases as may also require resection of the glenoid cavity of the scapula.

§ 2.—Resection for False Joint in the Humerus.

Resection of the ends of a false joint in the Humerus has been attempted in several instances; but as this complaint has frequently been cured by the introduction of a seton, as suggested by Physick,‡ and by the application of caustic by Barton, of Philadelphia,§ the resection of the bones has not often been necessary. It has, however, been accomplished in the United States, by Kearny Rodgers, of New York,‖ and many others, by making an incision over the seat of the joint, exposing the ends of the bones, turning them out, sawing them off, and then treating the case as a recent compound fracture of the arm.

As a means of curing false joint, a resection, or any other operation which creates a wound, is liable to very serious objections, while the use of the apparatus which I have suggested¶ under the head of False Joint, and the certainty of the cure, or at least the restoration of the usefulness of the limb, is an additional objection against any operation.

When desired, the treatment of a false joint by the use of a seton may be accomplished in accordance with the original plan of Physick.

Operation of Physick, of Philadelphia.—In the year 1802, a patient afflicted with a false joint in the middle of the humerus was cured in the following manner:—

A long seton-needle, armed with a skein of silk, being prepared, extension and counter-extension of the limb was made by two assistants, and the seton passed between the fractured ends of the bone in such a manner as to avoid the course of the artery. A pledget being then applied on each orifice made by the needle, the silk was left in the wound, the arm in a few days placed in the splints, and the dressing renewed daily. For *twelve weeks* no amendment was perceptible; but, soon after, the patient complained of pain, the bending at the seat of fracture became less apparent, and in about *five months* the arm was as strong as ever.

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* Med. Recorder, vol. i. p. 365, 1818.
† Am. Journ. Med. Sciences, N. S. vol. xii. p. 330, 1846.
‡ Med. Repository, vol. vii. p. 122, 1804.
§ Med. Recorder, vol. ix. p. 275, 1826.
‖ New York Med. and Phys. Journ., vol. vi. p. 521, 1827.
¶ Vol. i. p. 664.

Brainard's operation by drilling has been already alluded to in connection with the subject of false joint.

§ 3.—Resection of the Elbow-Joint.

Resection of the Bones of the Elbow-Joint, like that of the shoulder, is also among the more modern operations of surgery, having been suggested by Park, of England, in 1781, and performed in 1782 by Moreau. The process of Moreau is that which has been most generally approved, and it has been selected with occasional modification as the plan of most of the operations performed in the United States.

Operation of Harris, of Philadelphia.*—In the case of a woman, twenty-six years of age, laboring under hectic fever with suppuration in the elbow-joint, the following operation was performed:—

The operating table being covered by a mattress, the patient was placed on it with her face downward, and with the posterior internal portion of the elbow presenting to the surgeon, while the point of a strong bistoury was passed transversely so as to divide the skin, connective tissue, and tendon of the triceps, above and close to the olecranon process, and extend from the radial side of one condyle of the humerus to near the inner condyle, avoiding the position of the ulnar nerve. Two longitudinal incisions, three inches long, were then made on each side of the transverse one, so as to form a letter H, and make two quadrilateral flaps, which, on being dissected off, fully exposed the joint. The soft parts at each side, including the ulnar nerve, being now drawn to one side, by means of curved spatulæ, the olecranon process was removed by the common amputating saw, Plate LXIX. Fig. 3. The condition of the joint was then carefully examined, and all the articulating surfaces being found in a carious condition, the head of the radius and the diseased surfaces of the ulna and humerus were perfectly removed with the bone-nippers, two branches of the articulating arteries tied, the joint carefully cleansed, and the parts closed by sutures, and dressed with angular splints. The patient ultimately recovered with considerable motion in the joint.

Remarks.—Since the introduction of anæsthetics, the pain and shock from this operation have been materially reduced, and the chances of success thereby increased. One of the chief difficulties attendant on its performance is the risk of wounding the ulnar nerve, and in the patient operated on by Harris this was increased by the thickening and adhesion of the soft parts. To obviate this, Dupuytren proposed to open the sheath of the nerve cautiously behind the internal condyle, as soon as the upper flap was dissected, and have it held inward and forward by an assistant during the operation. A reference to the Bibliographical Index at the end of this part will show the reports of the operations performed by Gurdon Buck, Jr., and Stone, of New York,† and by others. In the operation of Buck, (for the removal of the olecranon process,) two longitudinal incisions were substituted for that of the H, the horizontal cut being omitted, and the sides dissected up so as to expose the bone without dividing the attachment of the biceps tendon.

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* Am. Journ. Med. Sciences, vol. xix. p. 341.

† Ibid., vol. v. N. S. p. 299.

This is a valuable improvement on the H incision, and should be employed wherever it is admissible.

In two instances I have operated by an L-shaped incision, and once by the H, with entire satisfaction. When the latter incision is preferred, it is better to make the first longitudinal cut directly over the course of the ulnar nerve, and have it held to one side during the remainder of the operation. The single vertical incision in the middle of the elbow does not usually expose the joint with sufficient freedom.

§ 4.—Resection of the Bones of the Forearm and Hand.

The **Bones of the Forearm** may be resected at any portion of their length; the removal of the upper articulating surfaces, and especially of the olecranon process, belong, however, to the operation just detailed as resection of the elbow-joint, while the removal of the lower constitutes resection of the wrist.

I. **Resection of both Radius and Ulna.—Operation of Compton,**[*] of New Orleans.—A boy, aged fifteen, having received a compound comminuted fracture of both the radius and ulna, as well as other injuries, on board ship, remained some days without proper treatment, the arm being in a sloughing condition, and the bones protruding several inches out of the mass of muscles. About two months subsequently, having otherwise recovered, Compton made a straight incision the whole length of the inner side of the radius, and a counter-opening opposite the olecranon process; dissected out both bones carefully; disarticulated them at the elbow, and removed them entire with the exception of the lower end of the radius, a great portion of the periosteum being, however, detached by nature and left in the wound.

This patient subsequently recovered; had entire use of the hand, so as to open and shut it; could grasp objects firmly, and had a firm forearm, although it was shortened about three inches. The forearm remained at a right angle with the humerus; but it could be flexed and extended so that the hand moved through eight or ten degrees of an arc of a circle. The pulse was readily perceptible in the boneless forearm.

II. **Resection of the Body of the Ulna.**—The ulna or radius, when diseased to a considerable extent, may be removed from the arm without necessarily destroying the usefulness of the limb.

Operation of Butt,[†] of Virginia.—This operation, which was performed in 1825, has generally been referred to by European writers as extirpation of the **Radius** instead of the ulna, which was the bone resected by Butt, in consequence of a long-continued necrosis, each writer who has quoted it having apparently copied the previous statement without investigating the original paper.

Operation.—The patient being seated in a chair, and the tourniquet applied as usual, a transverse incision was made down to the bone, about four inches and a half below the olecranon, and extending to a little more than half the diameter of the arm. A longitudinal one intersecting the lower part of this cut being then made in the line of the most superficial part of the bone, and extended to the wrist-joint, the dissection of the soft parts around the bone was commenced at the transverse incision, and carried down three inches, until a spatula could be insinuated beneath the bone, so as to protect the soft parts from the action of the saw. The ulna bein now divided transversely, the dissection was continued along the whol course of the bone down to the wrist-joint, a piece of twine being passe around the denuded end of the bone, so as to enable an assistant to elevat it, after which the bone was disarticulated from the wrist and removed, Plat LXIX Fig. 5. The wound being cleansed, the tourniquet was loosened the ulnar and interosseous arteries tied, and the edges of the longitudin incision closed by adhesive strips, and that of the transverse by sutures. I three months the patient was enabled to pursue his usual avocation as carpenter, flexion, extension, and rotation of the wrist being as free and uninterrupted as ever; declaring subsequently that he had as much strength i his hand (the left) as most people had in the right.

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[*] New York Journ. of Med., vol. x. N. S. p. 135, 1853, from the New Orleans Medical Register.

[†] Phila. Journ. Med. and Phys. Sciences, vol. i. N. S. p. 115, 1825.

III. **Resection of the Inferior Extremity of the Ulna.—Operation.—** "The hand being carried outward, make a longitudinal incision along th internal border of the ulna, and terminate it inferiorly by a transverse cu across the back of the joint. The triangular flap thus made being now raised and carefully dissected back, the tendons should be drawn aside, th artery avoided, and the bone disarticulated. A small piece of wood bein then passed beneath the end of the bone, it may be readily sawed through,"[*] Plate LXIX. Fig. 6.

Remarks.—The success attending resection of the ulna has certainly bee such as may induce others to repeat the operation in similar cases rathe than amputate the limb; and in the variety of diseases of this bone which are met with from time to time, the surgeon should hesitate a long time before consenting to such a mutilation as is caused by amputation, especially if the arm is the right one. Resection of the ulna, like resection of the head of the humerus, is an operation that has hardly been fairly developed by American surgeons, though a case of resection of the middle two-thirds of the bone, which resulted most fortunately, was reported[†] by Carter Johnson, of Richmond, Va.

In operating upon the radius, the same steps would be required as are described for the resection of the ulna; but the subsequent usefulness of the limb will be necessarily much more impaired, as the hand would be thrown out of its line with the arm, and pronation and supination destroyed.

IV. **Resection of the Wrist-Joint.**—In the case of a dislocation of the bones of the forearm upon those of the carpus, in such a manner as to forbid their reduction, the resection of the inferior extremities of the radius and ulna has been advised and successfully practiced. It has also been recommended to apply this resection to cases of caries of the wrist; but any one at all familiar with the structure of this joint must readily see that such an operation could offer but little prospect of success, except at the expense of a stiff wrist, as, under such circumstances, the bones of the carpus would probably participate in the complaint. Many cases will, however, be found in which, even with a stiff wrist, there may be considerable motion in the fingers, especially if the surgeon is careful throughout the treatment to flex them frequently, so as to prevent the tendons from becoming adherent to the front of the capsule of the inflamed joint.

Operation of Velpeau.[‡]—By an incision on each side of the forearm, reaching from the root of the thumb, and from the last metacarpal bone upward, for two inches above the level of the styloid process of the radius, and united by a transverse incision, a flap is formed and turned from above downward over the back of the hand. The articulation being now carefully opened, and the ends of the bones turned out, the tissues on the front of the arm are to be dissected off, so as not to injure the radial and ulnar arteries, when a thin piece of board or lead being passed beneath, the bones may be readily sawed off with the amputating saw. The flap being replaced and united by sutures, Plate LXIX. Fig. 7, gentle pressure will unite it to the anterior surface, and the hand be ultimately useful to some extent.

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[*] Bernard and Huette.

[†] Philadelphia Med. Examiner, vol. vii. N. S. p. 644, 1851.

[‡] Velpeau, Op. Surg.

V. **Resection of the Metacarpus.**—One or more of the last four metacarpal bones may occasionally require resection in their middle, in consequence of a limited caries, or deformed fracture. When needed, the bone should be carefully exposed from the back of the hand by an incision parallel with its length, the tendons and other soft parts being protected from the knife, and then the bone either disarticulated at its extremities, or else a portion excised by the bone-nippers.

Resection of the Metacarpal Bone of the Thumb is to be accomplished by a longitudinal incision, similar to that referred to under amputations, and shown in Plate LXXIV. Fig. 7.

The operation presents, however, but an uncertain prospect of success, as regards the ultimate usefulness of the remaining portion of the thumb.

VI. **Resection of the Bones of the Hand.**—The **phalangeal articulations** may require resection, in consequence of their becoming anchylosed in a straight position, and causing the patient the inconvenience of a straight and stiff finger. Under such circumstances, the bone should be exposed on the back of the finger, a V-shaped piece sawed out with a fine watch-spring saw, the finger kept flexed like a hook, and the parts allowed to heal in this position.

CHAPTER V.

OPERATIONS ON THE BONES OF THE LOWER EXTREMITY.

THE success attending the resection of the bones of the lower extremity has been much more brilliant than that ensuing upon the operations performed on the thoracic limbs; and it is to the surgeons of the United States, and especially to Barton, of Philadelphia, that the world is indebted for a most happy illustration of the advantages to be gained from a scientific application of mechanical principles, especially when aided by the efforts of nature, in the formation of a new joint.

SECTION I.

RESECTION OF THE FEMUR.

The **Femur** has been resected at its head, trochanters, shaft, and condyles, either for the removal of such portions as were diseased, or to restore the usefulness of the limb.

PLATE LXX.

RESECTION OF THE BONES OF THE LOWER EXTREMITIES.

Fig. 1. Barton's Operation for Resection of the Neck of the Femur, and the formation of a False Joint in a case of Anchylosis of the Hip. 1, 1. The flaps of the integument formed by a crucial incision, and turned back. 2. The incision of the muscles over the trochanter major. 3. The retractor passed around the bone, to protect the soft parts from 4, the narrow saw.

After Nature.

Fig. 2. Sedillot's Operation for Resection of the Head of the Femur in Caries. 1, 1, 1. The semilunar incision through the soft parts, convex above, and exposing the joint. 2. A strip slipped beneath the bone. 3, 4. The chain-saw in the act of excising the head of the bone. *After Bernard and Huette.*

Fig. 3. Barton's Resection of the Femur by the removal of a V-shaped piece in order to straighten a limb which was anchylosed at the knee nearly to a right angle. The flap has been reverted to show the section of the bone.

After Nature.

Fig. 4. Resection of the Lower Extremity of the Femur. 1, 1. A Retractor applied to the soft parts. 2. Strips beneath the bone. 3. The portion of the femur to be excised. 4. The amputating saw. *After Bernard and Huette.*

Fig. 5. Resection of the External Malleolus. 1. The left hand of the surgeon. 2. The chisel. 3. A steel hammer. *After Bernard and Huette.*

Fig. 6. Roux's Operation for Resection of the Lower Extremity of the Tibia. The soft parts being freed by a vertical incision, a retractor, 1, has been passed beneath the anterior flap to elevate it. 2. A strip beneath the posterior edge of the bone. 3. A small saw, dividing the bone before it is reverted and disarticulated. *After Bernard and Huette.*

Plate [illegible]

Fig. 1.

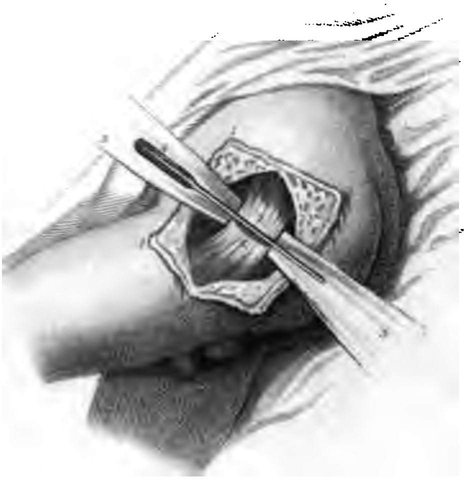


Fig. 2.

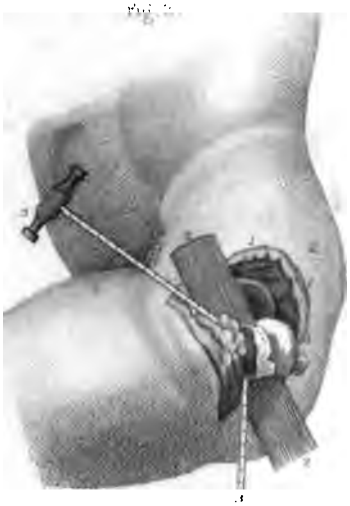


Fig. 3.

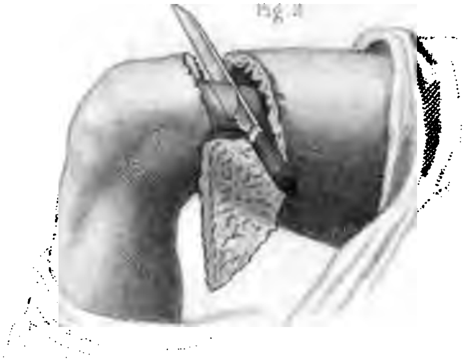
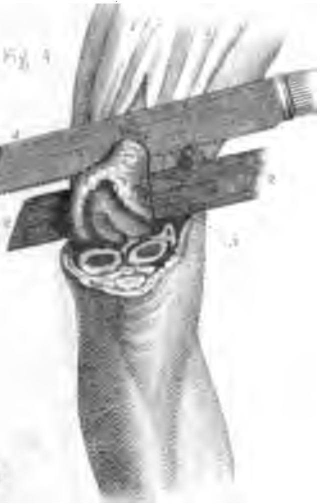


Fig. 4.



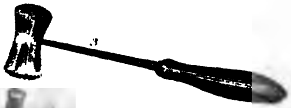


Fig. 5.

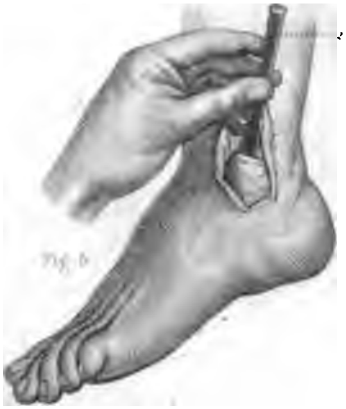
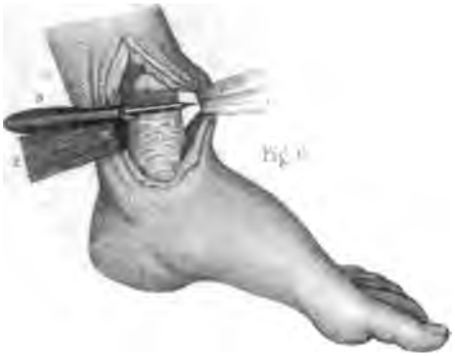
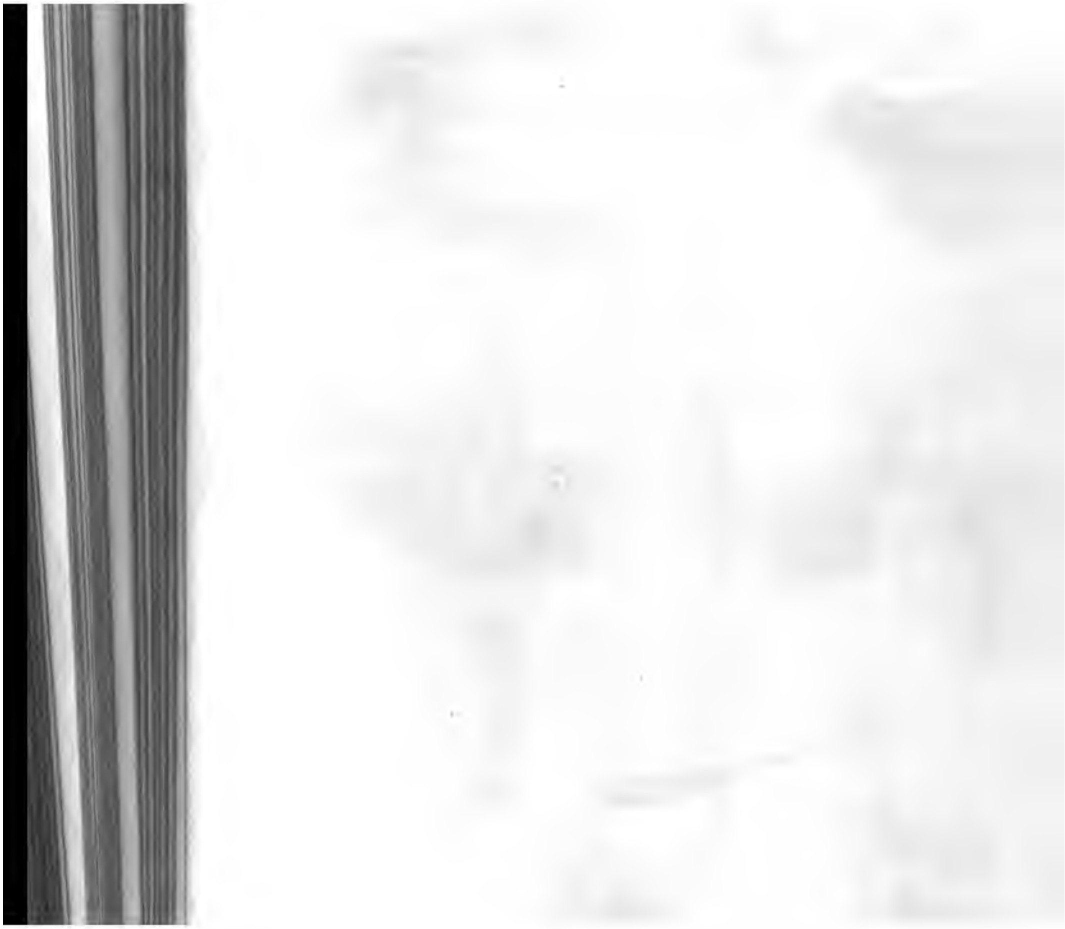


Fig. 6.





§ 1.—Resection of the Head of the Femur.

The **Head of the Femur** has been removed in cases of compound fracture, coxalgia, and caries, especially the latter; but though some few patients have ultimately recovered, it has only been after a long-continued and dangerous illness arising from the free suppuration and hectic fever which supervened; and these few were children about fourteen years of age, who were afflicted with caries. The operation should therefore be considered as a most dangerous one, and as especially unjustifiable in **Coxalgia**, as the natural tendency of the complaint is to a cure, and anchylosis is more apt to follow the resection than it is to ensue on the progress of the disease under the recent improvements in its treatment suggested by Davis, of New York, and already described. A reference to Plate LXX. Fig. 2, will sufficiently explain the steps to be pursued should any surgeon feel justified in attempting it.

§ 2.—Resection of the Femur for Anchylosis, and Formation of a new Joint at the Hip.

Operation of Barton, of Philadelphia.*—A young man, twenty-one years of age, having his thigh immovably flexed at a right angle with his pelvis, and carried across the opposite thigh, while the foot rotated inward, was operated on as follows:—

The patient being laid partially on the opposite side, a crucial incision, seven inches long, was made over the prominence of the trochanter major, and a transverse cut of five inches made to cross it at the same point. The four flaps thus formed being dissected back, the fascia was freely opened, and the muscular fibres over the trochanter incised and detached from around the bone, so as to permit the two index fingers to be passed around the neck of the femur, until they met on the opposite side. With the strong, narrow saw, Plate LXXI. Fig. 12, the bone was then nearly divided through the upper part of the great trochanter; and the neck, when the limb had been adducted, was drawn into its proper line, and the remaining portion snapped. No artery was cut; the wound was closed by a few sutures, and then dressed in Physick's modification of Desault's splints. The patient subsequently recovered, and by the formation of a false joint, produced at the resected portion, had, during six years, a limb upon which he could walk without apparent lameness. Kearny Rodgers, of New York, about four years afterward successfully performed a similar operation.†

SECTION II.

RESECTION OF THE KNEE-JOINT.

In cases of anchylosis of the knee-joint, the resection of a V-shaped piece of the femur was suggested by Barton as a means of furnishing a useful limb, especially when the joint is bent. As this operation has since been successfully performed, and repeated by various surgeons in the United States, it is now justly regarded as a standard one in cases of true anchylosis resulting in permanent flexion of the knee.

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* North Amer. Med. and Surg. Journ., vol. iii. pp. 279, 400, 1827.

† Am. Journ. Med. Sciences, vol. i. N. S. p. 507, 1840.

Operation of Barton, of Philadelphia.*—A physician, having his leg permanently flexed and anchylosed upon the thigh, to a degree somewhat less than a right angle, as the result of inflammation which had existed in childhood, determined to obtain relief, and underwent the following operation in the hands and at the suggestion of Barton, on the 27th of May, 1835:—

Operation.—By an incision which commenced at a point opposite the upper and anterior margin of the external condyle of the femur, and passed obliquely across the front of the thigh to terminate on the inner side, the soft tissues were incised. A second, which commenced on the outer side, about two and a half inches above the first, and also passed obliquely across the thigh to join the other in an acute angle, being now made, the tendon of the quadriceps femoris, and some of the fibres of the muscles, were divided, the flap turned back, the bone freely exposed, and a triangular, or wedge, or V-shaped piece of bone, Plate LXX. Fig. 3, easily removed by means of a small narrow-bladed saw. This wedge of bone not including the entire diameter of the femur at this point, a portion of the shaft of the bone was left undivided posteriorly, that it might at first protect the artery from the saw, and, by subsequently interlocking the fragments, prevent the sharp edges of the bone from injuring the soft parts. By slightly bending the leg backward, these fibres were now gently broken, and the operation, which lasted about five minutes, entirely completed.

No blood-vessels being injured, the flap was restored to its place, the wound lightly dressed, the patient placed in bed upon his back, and the limb supported upon a splint *of an angle corresponding to that of the knee before the operation.* This position being retained until it was supposed that the asperities of the bone were removed, a splint with a more obtuse angle was applied, and changed from time to time until the limb had attained a position almost straight, when it was kept permanently in that line until the bones united. During the treatment, special care was taken to protect the popliteal vessels from pressure by employing long hair bags at the sides of the splint, so as to leave a vacancy in the course of the artery, the interspace being filled with lightly-carded cotton. The constitutional symptoms, though somewhat severe, resembled those usually seen in a compound fracture; but in four months the patient stood erect, with the feet in their natural position, and both heels touching the floor, although a slight angle had been designedly left at the knee in order to obviate the necessity of throwing out the limb in the act of walking, which would have been the case if the knee had been kept perfectly straight. The patient ultimately recovered perfectly. A reference to the Bibliographical Index at the end of this part will show that this operation has been repeated in the United States by Gibson, Pancoast, and Mütter, of Philadelphia; by Burr, of Louisiana, and in a modified form by Buck, of New York, and Wedderburn, of New Orleans.

Remarks.—In the observations of Barton, connected with the history of this case, there may be found some most valuable remarks on the advantages of the plan which he pursued, and especially on the value of the section of the bone at a proper angle. To obtain this, and it is essential to the cure, it will be found advantageous to resort to the rule proposed by Goddard, of Philadelphia,† and practiced by Mütter, which is as follows: "Take the angle of deformity, and then remove from the bone the complement of the angle." The use of Stromeyer's splint, as employed by Mütter in his case, would also be an improvement on the original dressing, as the popliteal space will thus be left entirely free from pressure, and the limb may be readily and gradually extended as required.

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* Am. Journ. Med. Sciences, vol. xxi. p. 332, 1837.

† Philad. Med. Examiner, vol. vii. N. S. p. 39, 1851.

§ 1.—Removal of a Portion of the Patella, Condyles, and Articulating Surfaces of the Tibia.

Operation of Gurdon Buck, Jr., of New York.*—A patient, twenty-two years of age, had his right knee anchylosed at a right angle, in consequence of traumatic inflammation, seven years previous. The condyles of the femur were prominent, and stood in advance of the tuberosity of the tibia, with the patella deeply and immovably imbedded between them; the tendons in the ham stood out in bold relief from the limb, but the surrounding soft tissues were healthy, though the deformed limb was shortened and less developed in every respect than its fellow. By modifying the operation of Barton, it was supposed that it would be feasible to obtain greater strength of limb, and less remaining deformity.

Operation.—The hamstring tendons having been divided, some days before, by a subcutaneous section in which the peroneal nerve was cut across, the patient was placed in a proper position, the tourniquet applied, and an incision made from the outer to the inner condyle, across the middle of the patella, and a second incision from the middle of this, perpendicularly, downward to the tuberosity of the tibia. The integuments being dissected as low down as a finger's breadth below and parallel with the margin of the articulating surface of the tibia, the ligament of the patella and the fibro-ligamentous tissues on either side were cut through on the same level, to nearly the extent of two-thirds of the circumference of the bone. A section of the tibia was then made, three-fourths of an inch below the joint anteriorly, and directed obliquely upward so as to terminate at the margin of the articulating surface posteriorly, two-thirds of this section being accomplished by the amputating saw. Another section was then made with the same saw through the upper part of the patella, parallel with the first, and on a plane forming an angle with it less than a right angle, and continued to about the same extent, the remainder of the section through the tibia and condyles being completed with a metacarpal saw. This wedge-shaped piece being now removed, it was found that the section had not divided the posterior portion of the condyles, which still remained consolidated with the tibia. A new section was therefore undertaken, commencing upon the cut surface of the femur three-fourths of an inch anterior to the angle at which the previous sections met, and directed more obliquely upward and backward. The remaining points of connection being then cautiously ruptured by flexing the leg, the rough prominences were pared away with the bone-nippers. On attempting to extend the leg, it was found that the bony surfaces could only be brought to within a finger's breadth anteriorly, as the soft parts in the ham offered great resistance. These were therefore dissected up, and a further section, five-eighths of an inch thick, removed from the anterior two-thirds of the femur, which enabled the surgeon to extend the leg and bring the bony surfaces in contact. The section of the condyles now exceeding that of the tibia in its antero-posterior diameter, there was an overlapping in front of about half an inch. But two ligatures were required; and the soft parts posterior to the joint, and separating it from the artery, were very little disturbed, but the angular flaps of integument being redundant were pared away to the requisite extent, and secured in contact by seven sutures.

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* Am. Journ. Med. Sciences, vol. x. N. S. p. 277.

The limb being then placed on an inclined plane, adhesive strips were applied between the sutures, and dry lint laid over the whole. The operation lasted forty minutes, and the patient left his bed in about three months with an apparatus, but shortly recoverd, and was able to walk on a sort of stirrup-iron beneath the foot, the leg on this side being about five inches shorter than the other at the heel, though half of this might be ascribed to the defective development of the limb subsequent to the inflammation of the joint.

Remarks.—Resection of the knee-joint, for the cure of more or less extensive disease of this articulation, is an operation suggested nearly a century since, but only especially lauded by the English surgeons since the year 1850, when its advantages were described by Fergusson. That the former opinions of surgeons in regard to the serious constitutional disturbance consequent on wounds of the larger articulations should be modified, is not surprising, in view of the facts collected in connection with the often useful injection of iodine into cavities formerly thought to be safely approachable. Hence we find modern surgery counseling the extensive opening of the knee and hip-joint, with removal of the diseased articulating surfaces, and offering some cases of success as evidence of the propriety of this operation. As compared with the mortality consequent on amputation of the thigh, resection of the knee has been by many regarded as the more favorable operation; and statistics, while augmenting the field of observation, has not materially changed the proportion of deaths. Watson* and Butcher,† of Great Britain, have recently shown that of 91 cases 63 recovered, with limbs that were comparatively useful, or only 28 deaths; while of 128 secondary amputations through the thigh for disease, only 63 recovered. That is, after resection of the knee-joint, there was nearly one-third less deaths than after amputation.

Operation of Watson.—Make a straight incision across the middle of the patella, from one side of the knee to the other. Cut out the patella, thus opening the joint, and remove the diseased surface of the bone by the saw, inclining it on the condyles of the femur at an angle of 45°. Then cut off the head of the tibia, so as to make a concavity to receive the end of the femur; any other diseased parts being also removed. After straightening the limb, close the flap by a few stitches of the metallic suture, keeping the angles or ends of the incision open to give exit to the discharge. Ligation of the articulating arteries arrests the hemorrhage.

In bad cases attended by marked swelling and flexion of the leg, an incision somewhat similar to that of Bauden's for amputation—that is, semicircularly and convex downward—would answer better. In all cases the after-treatment should be carefully attended to—opium, quinine, iron, etc. being judiciously administered, to counteract the tendency to hectic; while the limb should be carefully kept in the extended position, by any hollow splint or support, as that similar to Amesbury's, that will obviate pressure on the popliteal region. Much of the success will, it must be recollected, depend on a judicious selection of patients, and careful constitutional treatment subsequently; the cure being tedious, and the patient apparently brought to the verge of the grave.

Remarks.—The selection of any plan of operating being probably influenced by the peculiar difficulties of the case, it is not possible to make a just comparison between any two methods. The opinion of a want of strength in the support afforded by the operation of Barton, which seems to have originated the plan pursued by Buck, is, however, an erroneous one, as has been proved in several instances; while the section above the condyles, as practiced by Barton, can be made to remove the obstacles connected with contractions about the ham. Except under peculiar circumstances, I think therefore that the operation above the knee would be the best, as it causes little deformity from shortening, and is much more simple.

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* Glasgow Med. Journ., Oct. 1859.

† Dublin Journal Med. Sciences, No. 53.

§ 2.—Resection of the Bones of the Leg.

Resection of the Bones of the Leg, in order to cure a false joint, has been repeatedly performed, but requires no special description, being effected usually by incising the soft parts, turning out the ends of the bones, sawing them off, and then treating the case as a compound fracture. In the leg this operation is much more serious in its results than it is in the humerus, and it is also one that exposes the patient's life unnecessarily, especially as a cure may be accomplished, or a useful limb obtained with less risk, by means of the artificial limb or splints applied so as to enable the patient to walk about during the progress of the cure, as has been stated in the section on False Joint.

A partial resection or perforation of the tibia, or a perforation of its shaft by a trephine, is sometimes required in order to give vent to accumulations of pus within its cancellated structure, when the diagnosis is positive, as has been already alluded to under the head of Ostitis.

Removal of seven inches of the Tibia.*—E. S. Cooper, of San Francisco, relates a case in which seven inches of the shaft of the tibia were successfully removed. The patient, aged 28 years, had suffered from constant pain in the right tibia for 17 years, and for six months been able to walk but little. The upper part of the tibia was greatly enlarged and painful to the touch. Suppuration of the bone was diagnosed, and the diseased bone removed by the following operation:—

Operation.—The patient being chloroformed, an incision was made, nine inches long, commencing at the tubercle of the tibia and continuing down its spine. The first incision was carried through the integument, fascia, and periosteum, down to the enlarged and softened bone. The periosteum, thickened to four or six times its natural condition, and but loosely attached to the bone, was next turned aside with the soft parts, leaving the bone naked for more than seven inches. The tibia being then divided with a chain-saw near the lower terminus of the incision, and at the tubercle, the diseased portion was removed, the wound packed with lint, the flaps of the soft parts laid loosely over it, and the whole secured with a bandage. The upper part of the tibia which was left, being somewhat diseased, was stimulated from time to time, after suppuration was established, by a weak solution of chloride of lime, attenuated with black lotion. The bone thus removed was rapidly reproduced, and four months after the operation the patient could walk with the aid of a cane.

About this time he fell and fractured the new bone, thus creating a pseudarthrosis. When this condition was recognized, Cooper cut down upon the bone, removed a partly developed synovial membrane from between the ends of the fragments, and, drilling them in two places, introduced two silver ligatures, which kept the ends of the fragments in apposition until bony union was effected, which was in about three months. The wires were removed about the tenth week.

Five months subsequent to this last operation the bone was almost as strong and firm as the tibia of the opposite leg. The patient has since enjoyed good health.

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* In the New Orleans Medical News and Hospital Gazette for Dec. 1859.

§ 3.—Resection of the Fibula.

The **Fibula** has been resected as follows: Make an incision down to the bone at its central portion, denude it of the soft parts, pass the chain-saw around, saw it across, and then disarticulate it at each extremity. But in removing the upper portion the surgeon will probably be compelled to divide the anterior tibial nerve, where it winds round the neck of the bone.*

Remarks.—As this bone is seldom diseased without the tibia being similarly affected, its separate resection is a rare operation.

SECTION III.

RESECTION OF THE ANKLE.

One or both bones of the leg may be resected at the ankle-joint, in the manner described in the ensuing cases.

§ 1.—Resection of the Inferior Extremity of the Tibia and Fibula.

Resection of the Inferior Extremity of the Bones of the Leg has been performed in cases of severe wounds of the ankle-joint complicated with dislocation, as well as in those of compound fracture. These operations have, in a few instances, been attended with more success than might have been anticipated from a knowledge of the structure concerned; a French surgeon named Josse "having removed, in one instance, two inches of the right tibia, and in another more than an inch from the left tibia and fibula of a patient, who yet, at the end of three months, walked with the aid of a cane."† Cooper's case, of San Francisco, has also been just stated. Such cases must, however, be regarded as wonderful instances rather than as ordinary examples of success. More frequently the patient will suffer from severe constitutional disturbance, and, if he recovers, is apt to have a limb considerably shortened, as well as a stiff ankle. It becomes, therefore, questionable whether, under such circumstances, an artificial foot and leg would not answer better than the natural one. When, however, it is desired to perform this resection, it may be accomplished in several ways.

Roux's Operation.—Make a longitudinal incision, three inches long, on the outer side of the fibula, commencing above the external malleolus. From the inferior extremity of this, carry a transverse incision as far as the tendon of the peroneus tertius. Dissect up the flap, and open the sheath of the two other peronei tendons, push them back, expose the fibula from behind, avoiding the vessels and nerves; insinuate a chain-saw between the tibia and fibula from within outward, divide the bone, raise up its lower extremity, and disarticulate it. Then place the leg on its external side, and make a longitudinal incision on the tibia from the internal malleolus, about three and a half inches upward, and from its extremity make a transverse cut as far as the tendon of the tibialis anticus. Dissect up the flap, and isolate the surrounding parts by passing a piece of pasteboard beneath the bone, drawing the vessels and tendon to one side, and then cut across the bone with a narrow saw. The tibia being thus divided, it is to be disarticulated in the same manner as the fibula,‡ Plate LXX. Fig. 6.

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* Malgaigne.

† Velpeau, Op. Surgery, by Mott and Townsend, vol. ii. p. 822.

‡ Bernard and Huette, Med. Operat., p. 103.

§ 2.—Resection of the Astragalus.

The removal of any of the bones of the tarsus must be the result of circumstances, and the only direction which can be given in relation to them is to open the integuments freely at the most prominent point of the bone, and then free its attachments. It is, however, desirable that the wound should be so contrived as to place the cicatrix at such a point as will not expose it to pressure or friction in the act of walking, in order to prevent the constant recurrence of ulcers in this part.

The **Astragalus** has been successfully removed in cases of compound dislocation, by Stevens, of New York;* Gillespie, of Virginia;† Barton, of Philadelphia, in 1831;‡ Norris, of Philadelphia, and by several other surgeons. There is, therefore, sufficient evidence to show that, in compound dislocations of this bone, it is desirable to attempt its resection or extirpation before resorting to amputation of the leg. As the operation has been limited to compound dislocation, the removal consists in freeing the bone from its attachments through the wound caused by the injury.

§ 3.—Resection of the Os Calcis.

Within the last few years the progress of conservative surgery has led several surgeons to attempt the resection of bones which it was formerly thought could not be removed without destroying the utility of the limb. Among the most marked of these has been the resection of the entire os calcis, which, in the hands of Hancock, Wakley, Greenhow, Potter, Page, Gay, Simon, Lowe, Field, and others in England, has resulted favorably. In a report on this operation by Greenhow, of Newcastle, England,§ twelve cases are mentioned, of which ten were reported as successful, the caries or necrosis having, in several instances, involved the other bones of the tarsus to some extent. The disease had lasted from eight weeks to ten years, and in some of Greenhow's cases the bone was so carious "as to resemble a very porous sponge." The experience of the surgeons above named has shown that the preconceived objections to this operation are invalid: "the incisions healed readily, in some instances even by the first intention; the joint was generally very movable; the tendo-Achillis attached itself perfectly to the soft parts, (muscles and integuments of the heel,) adapted itself to the new condition of the ankle; the foot was at once put in a comfortable state; and the patient at last had a limb which was almost as serviceable to him as its fellow." The mode of operating has necessarily been varied, owing to the peculiarities of each case, some of the surgeons preserving the sole of the foot entire, and others forming a flap or flaps from it.

Hancock's Operation.—A single flap was formed in the sole of the foot, with its convexity looking forward, by an incision which commenced at one malleolus and ended at the other.

Greenhow's Operation.—In four cases this surgeon operated as follows: In three cases the incisions were made first from the inner and outer malleoli to meet at the apex of the heel, and then others extended along the side of the foot, the flaps being dissected back so as to freely expose the bone and its connections. In the fourth case the incision commenced at the point of the heel, was carried slightly upward toward the inner malleolus, and then slightly downward and forward. This being repeated on the external side, two curved flaps were formed and dissected upward and downward.

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* New York Med. and Phys. Journal, vol. v. p. 560. 1826.

† Am. Journ. Med. Sciences, vol. xii. p. 552. 1833.

‡ Liston's Pract. Surgery, Philada. edit p. 141. 1842.

§ Brit. and Foreign Med.-Chirurg. Rev., No. xxiii. p. 233, July, 1853.

§ 4.—Resection of the Metatarsal Bones and Phalanges.

The resection of the **Metatarsal Bones** and the **Phalanges** of the toe is to be conducted on the same principles as similar operations in the hand, the incisions to expose the bone being similar to those described hereafter under Amputations of the Foot.

CHAPTER VI.

GENERAL REMARKS ON AMPUTATIONS.

As the amputation of a large limb necessarily destroys the equilibrium which had previously existed in the forces of the economy, it should always be regarded as a serious operation, and liable to involve the life of the patient. As it also removes a part which is often essential to the daily maintenance of the individual, and, in too many instances among the laboring classes, renders them paupers for life, it is an operation which should be resorted to as seldom as possible, and only when a careful review of the moral and physical condition of the patient establishes the fact that the mutilation of the body is better than the loss of life. Possessed of a very moderate amount of mechanical skill, and with a little resolution, any one may be able to perform an amputation; and the renown sometimes supposed by young surgeons to be attached to the performance of this operation may well be deemed of a doubtful character, as it tacitly implies that, by a more judicious and skillful treatment, they might perhaps have avoided such a mutilation. As such an operation is also liable to affect injuriously the reputation of a young surgeon, it will prove to be a good rule never to amputate a limb without having a consultation with two or more practitioners, if it is at all possible to obtain their opinion, as the most serious cases have occasionally recovered without losing the limb, even when the surgeon has openly declared such an event was impossible; while, on the other hand, legal proceedings on a charge of malpractice have been subsequently instituted agaist the surgeon, when a patient has been disposed either to escape the payment of a bill or gratify a malicious disposition. Too much caution can then hardly be shown by the young surgeon in resorting to this operation, especially when it is not sanctioned by the opinion of his seniors. It is generally admitted that the average mortality after all amputations is about one in three of those operated on properly.

SECTION I.

CASES FOR AMPUTATION.

The propriety of performing amputation in cases of gunshot wounds and compound fractures, in gangrene, or for the removal of malignant growths, is a question on which there has been much diversity of sentiment; and, if my present limits permitted, this subject might be advantageously allowed to occupy several pages. I shall, however, be compelled to confine its consideration to a condensed statement of the opinions of distinguished authorities in a few of the more serious cases, and to the general statement that amputation is proper in any case only when the disease or injury which appears to demand it is otherwise incurable, or when the patient is so circumstanced that the omission of the amputation would increase the chances of death.

§ 1.—Gunshot Wounds.

The necessity of **Amputating in Gunshot Injuries** has generally been admitted to be regulated by the fact of the ball producing a compound fracture opening into a large joint, or mutilating some of the principal blood-vessels and nerves; but, in all these cases, the position and circumstances of the patient should not be overlooked, as injuries may demand amputation in the field, which, in private life, would recover without it.

The views of surgeons in regard to the indications for amputation in gunshot fractures differ somewhat, according to the position of the injury. In the femur, it is nearly universally admitted to be imperative. Thus, Ravaton thinks such a fracture is nearly always fatal; Ribes mentions that, in an aggregate of four thousand cases at the Hôtel des Invalides, in Paris, there was not a single cure; De Claubry, surgeon of the Imperial Guard, was of the same opinion, most of the soldiers in Spain dying unless the limb was promptly amputated; while Percy, Thompson, Larrey, Guthrie, and Hennen express nearly the same views.*

In opposition to such extended authority, it becomes any one to hesitate at the correctness of an opinion which is contrary to that thus expressed. Yet, having in five cases of bad compound fractures of the thigh from Minié balls succeeded in curing the patient, so that two were again able to enter the field, I dissent from so general a conclusion, and await the result of the extended experience furnished by the present war in which a great number of these injuries have been most admirably treated, owing to the comparative proximity of large towns and good hospitals to the field of battle. The cases referred to by me were treated by cold water and by simple extension by means of a weight, and without splints.

In the upper extremity the result has always been more favorable, and Guthrie states that "this limb should not be amputated for almost any accident that can be produced in this way."†

In four cases of Minié fractures of the humerus comminuting the bone, I removed several large portions of bone, and the patients in about nine weeks had useful arms. A noted instance of this was in the case of the Quartermaster of the 104th Regiment P. V.

In gunshot wounds of large joints, which produce fracture, the necessity

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* Velpeau's Op. Surg., by Mott, vol. ii. p. 454.

† Velpeau, loc. cit.

PLATE LXXI.

INSTRUMENTS FOR AMPUTATION, ETC.

Fig. 1. Trocar for Tapping the Bladder through the Rectum.
Kolbè's pattern.

Fig. 2. Petit's Tourniquet. “ “

Fig. 3. A Large Round-bellied Scalpel for dissecting back the integuments in the circular amputation. *Kolbè's pattern.*

Fig. 4. A Small Catlin for the interosseous space. “ “

Fig. 5. A Large Amputating Knife for the circular operation. “ “

Fig. 6. The Long Ten-Inch Catlin for the flap operation. “ “

Fig. 7. An Eight-Inch Catlin for the flap operation. “ “

Fig. 8. Bone-Nippers for removing any sharp points left by the action of the saw. *Kolbè's pattern.*

Fig. 9. Dissecting Forceps to hold the integuments while they are dissected from the fascia before they are reverted, as in the circular operation.
Kolbè's pattern.

Fig. 10. Spring Forceps, often called “Bulldog.” “ “

Fig. 11. Artery Tenaculum. “ “

Fig. 12. Barton's Metacarpal Saw. “ “

Fig. 13. Ordinary Metacarpal Saw. “ “

Fig. 14. The Large Amputating Saw. “ “

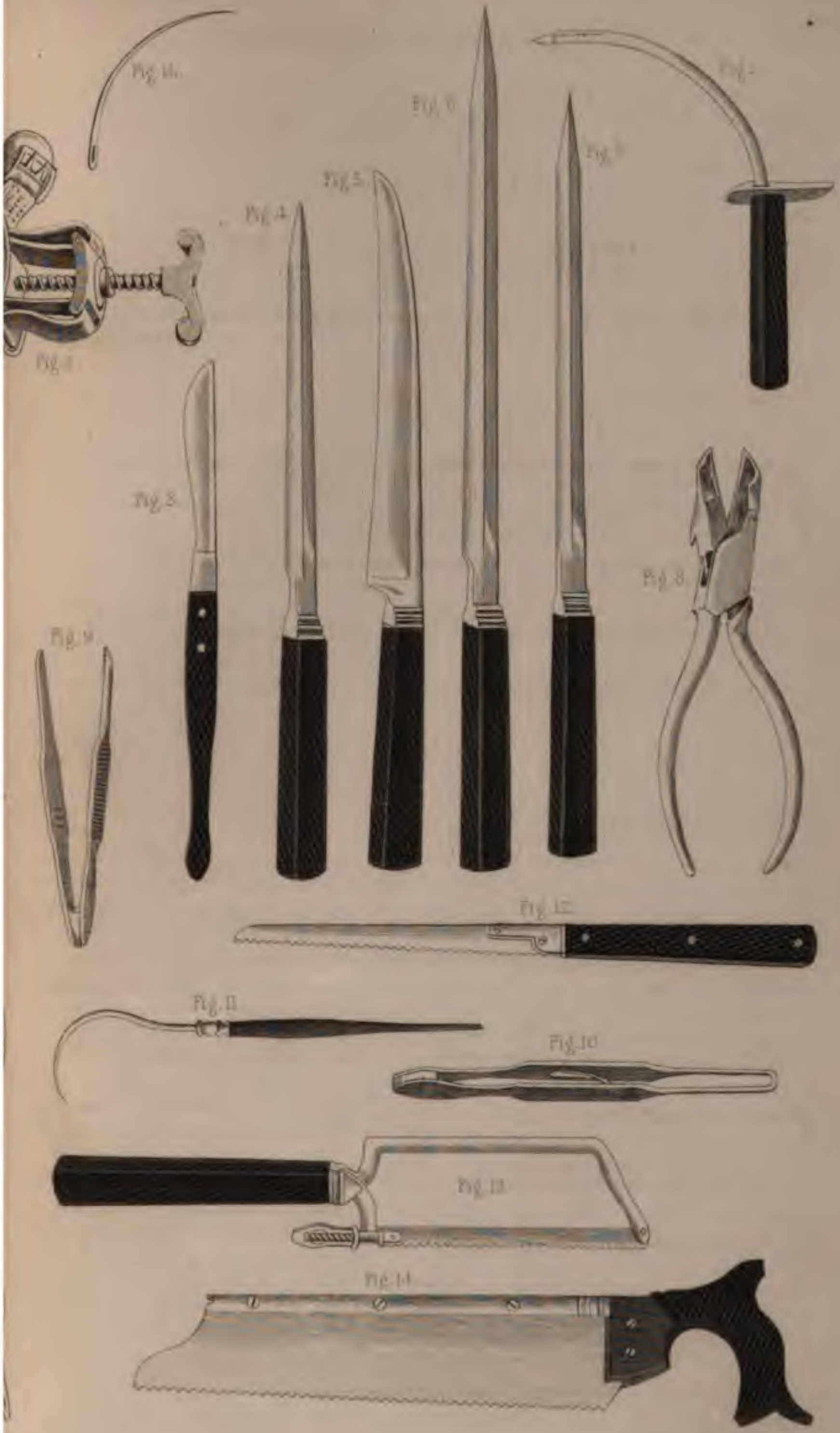
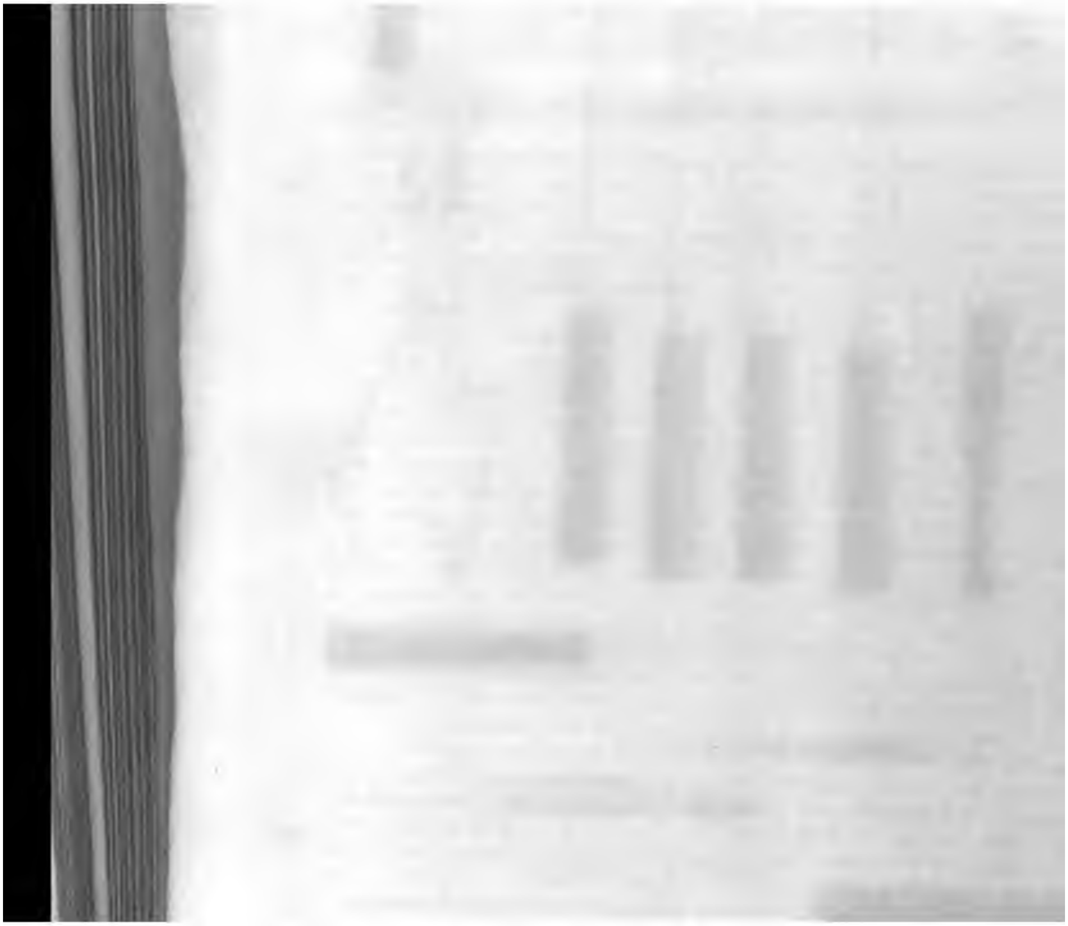


Fig. 15.
Fig. 2
Fig. 6
Fig. 7
Fig. 5
Fig. 4
Fig. 1
Fig. 3
Fig. 8
Fig. 9
Fig. 12
Fig. 11
Fig. 10
Fig. 13
Fig. 14



for amputation is generally regarded as settled, gangrene or tetanus being apt to follow; yet the success that has attended the use of the cold water-dressing, even in Minié wounds of the knee-joint, not inducing fracture of the bones, should be sufficient to cause a conservative surgeon to defer an amputation; and many cases can now be shown to have recovered in whom the knee-joint was directly opened. When, in any case, tetanus is developed or threatening, especially if the symptoms are well marked, it is useless to amputate, as it is only possible to remove the wound, but not the tetanic symptoms.

The advantages of secondary over primary amputations, in these as well as in other cases, will be referred to hereafter.

§ 2.—Railroad Accidents.

A class of injuries unknown to the older surgeons are now so common as to furnish those of the present day with many examples of compound fractures and dislocations of the most serious kind. These injuries, together with such as result from the use of thrashing-machines, as well as those created in mills and cotton gins, are the result of the application of force to the limb, in such a manner as to produce extensive contusion of the neighboring parts, as well as laceration at the seat of injury. It is therefore not uncommon, in amputations performed for the relief of such injuries, for the stump to slough after an attempt has been made to heal it, and this should always be guarded against by amputating sufficiently far from the seat of injury to be sure of a sound circulation in the flaps. This sloughing arises, according to Hayward, of Boston,* "from a condition of parts resembling that which has been spoken of by military surgeons as a local anæsthesia, and is a state of suspended animation differing from death only in the fact that the power of resisting decomposition is retained for a time, though certainly destroyed by the debilitating effects of the operation." The shock created by these accidents usually results in a state of extreme depression, and in such cases I think the amputation should always be delayed until reaction is established; though on this point there is a diversity of sentiment. One reason which has always influenced me in opposing immediate amputations, in cases of railroad accidents, is the fact of having repeatedly found them complicated with such internal injury as would result in death, independent of the condition of the limb. In nearly all instances of railroad injuries of the limbs, the patient is either first knocked down by a blow from the cars, or else falls or is thrown with violence upon the ground, the latter being generally uneven, and it is while in this position that the limb is injured by being run over. Contusions of the abdominal or thoracic viscera, or concussion of the spinal marrow or brain, with violent muscular inflammation, will therefore often be found to coexist with the compound fracture or luxation. In one instance in my own observation, this contusion resulted in laceration of the spleen, which caused death within twelve hours after the performance of amputation, although no complaint was made by the patient of any other injury than that of the leg; and in another, a rupture of a hepatic vein caused the death, though the amputation seemed likely to do well. By waiting till reaction is fully established, and the sensibility of the entire body restored, (say three days,) we will be rendered more certain of the patient's true condition; while, by resorting to anæsthetics, the shock of the amputation can then be fully obviated. Should a bad compound comminuted fracture of the extremities require amputation in order to arrest the hemorrhage, it would be desirable simply to divide the integuments, and remove the limb at the seat of fracture, and subsequently (two or three weeks) perform an amputation for the better formation of a stump. This suggestion,[*] which may be termed a partial or temporary amputation, is due to Horner, of Philadelphia, who tried it satisfactorily in two cases. My subsequent experience has altogether confirmed it, and the subject is well worthy the investigation of surgeons in charge of large hospitals in cities where railroad accidents are numerous.

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* Paper on Amputations in Massachusetts General Hospital, p. 16. Boston, September, 1850.

§ 3.—The Period for Amputating.

The advantages of **Primary** over **Secondary Amputations** are serious questions, and with respect to which there is a diversity of sentiment.

Larrey[†] asserts that, in the American war, the French surgeons lost almost all their patients by deferring their amputations, while the Americans, by immediate amputation, saved nearly all of theirs.

Velpeau,[‡] after a careful and learned examination of this question, states that amputation should in these cases be performed within the first twenty-four hours after the accident.

Sir George Ballingall[§] is "satisfied that in civil hospitals primary amputations do not do so well as in military life, owing to the difference of moral causes in these two conditions; the soldier being robust at the time of the accident, and brought to a purer air in a hospital than he had had in barracks."

Guthrie[‖] states that he regards the advantageous results of primary amputations, or those done within forty-eight hours, over all ordinary amputations, or those done at the end of several days or weeks, as being so firmly established as not to admit of dispute.

Sanson agrees with Ballingall in the statement that the striking advantages claimed for primary over secondary amputations, as observed in military practice, do not hold good to the same extent in civil hospitals, and explains it on various grounds; the most important of which is the transfer of a man accustomed to active labor and full diet with fresh air, to the close wards and life of a hospital, this alone being sufficient to excite constitutional disturbance.

Norris,[¶] in furnishing the statistics of the amputations in the Pennsylvania Hospital for the seven preceding years, shows that of 24 primary operations, 14 were cured and 10 died. In another paper,[**] containing the results of the same hospital from 1838 to 1840, he also shows that of 35 primary operations, 24 were cured and 11 died, and that of 25 secondary amputations, 13 were cured and 11 died. By combining these tables, he therefore concludes "that immediate amputations after injuries are less fatal than secondary, the mortality after the former being 1 in $3\frac{2}{11}$, and in the latter 1 in $2\frac{3}{7}$."

Hayward, of the Massachusetts General Hospital at Boston, in some valuable statistics from that institution,[††] affords the observer an opportunity of learning this fact, by comparing the date of admission with that of the operation, though he does not directly mention the fact of the operation being primary. From an examination of his dates, it appears that of fourteen primary amputations, ten were cured and four died; but he fears that the operation in recent injuries is often resorted to too early.*

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[*] Philadelphia Med. Examiner, February, 1853.

[†] Clinique Chirurg., tome iii. p. 518.

[‡] Op. Surg., by Mott, vol. ii. p. 470.

[§] Ibid., 471, note by Dr. Townsend.

[‖] London Lancet for May, 1853.

[¶] Am. Journ. of Med. Sciences, vol. xxii. p. 356, 1838.

[**] Ibid., vol. i. N. S. p. 38, 1840.

[††] Ibid., vol. i. N. S. p. 64, 1840.

Buel,† of the New York City Hospital, in an exceedingly well-arranged statistical table of the amputations performed in that hospital from 1839 to 1848, says: "That it is customary in the New York Hospital to amputate before the accession of inflammatory action, so that the occasions for secondary amputations are rare." The mortality after primary amputations was 27·77; of others 30·76 per cent. The mortality after amputations for chronic affections was 20·67.

Guersent, of the Children's Hospital in Paris, is opposed to hasty operations in the cases of children suffering from chronic diseases, especially white swelling, as the lymphatic habit may often be ameliorated, and a valuable though imperfect limb preserved. As a general rule, Guersent has saved eight or nine out of every ten operations. Much of his success is, however, attributed, by a writer in the *Bulletin de Therapeutique*, tome xl. p. 81, to his practice of ordering good and nutritious diet as soon as possible after the operation.‡

The most valuable contribution that has been recently made, to our knowledge, of the results of primary and secondary amputations in civil practice, is, however, that furnished in a recent paper by Stone,§ of New York City, and is among the most satisfactory of all the papers that have been published on this subject; the practice of military surgeons having apparently so settled the views of the civil surgeons on the advantages of primary amputations over secondary, that comparatively few have examined the subject without being previously prejudiced to their opinions. The Astor Place riots in New York having presented a large number of gunshot wounds and compound fractures, the advocates of primary amputations were surprised at the results of the practice in these cases, "nearly every case" being stated by Stone to have terminated unfavorably that was touched by the knife. He therefore collected extended statistics of the civil practice elsewhere, and found that the favorite doctrine of primary amputations was not supported by the result. After presenting several extended statistical tables of amputations in European and American hospitals, as well as in the military and civil practice, Stone‖ arrived at the following conclusions:—

"1st. That primary amputations of the upper extremities are equally successful, and to be preferred both in military and civil practice.

"2d. That in military surgery, primary amputations of the lower extremities are twice as successful as secondary.

"3d. That in civil surgery—that is, in American hospitals—it is immaterial whether primary or secondary amputations of the lower extremities are resorted to.

"4th. That secondary amputations of the upper extremities in civil surgery are 8 per cent. less fatal than in military surgery.

"5th. That secondary amputations in civil surgery are 12 per cent. less fatal than in military surgery.

"By adding together all accessible information in regard to amputations of the lower extremities in civil hospitals, both European and American, and comparing it with the results obtained in military hospitals," Stone found "that the mortality in primary amputations of the lower extremities in civil practice was 53½ per cent., and of secondary amputations 12½ per cent., or 32 per cent. in favor of primary amputations in military service compared with civil practice, and 36 per cent. in favor of secondary amp tations of the lower extremities over primary in civil surgery. He al found that there was a difference of 41 per cent. in favor of secondary a putations over primary in civil practice, and a difference of 9 per cent. favor of secondary amputations in civil practice compared with the prim amputations of military surgery.

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* Opus citat., p. 70.
† Am. Journ. of Med. Sciences, vol. xvi. p. 39.
‡ South. Med. and Surg. Journ., vol. vii. p. 379, from Med.-Chir. Review.
§ New York Journ. of Med., vol. iii. p. 297.
‖ Ibid., p. 305.

"He therefore concludes *that in military surgery, primary amputatio are to be preferred; that in civil practice, secondary amputations are be preferred; and that the secondary amputations of civil surgery a more successful than the primary of military surgery.*" Stone th closes his paper with some valuable data to show that, in all compou fractures, it is better to attempt to save the limb, and that very often t attempt will succeed under the most doubtful circumstances. It wou afford me much pleasure to extend the circulation of the many valuab facts collected by Stone's labors, were it compatible with my plan; b under present circumstances, I can only advise the reader to study his val able contribution to conservative surgery, being satisfied that he will the attempt to save many limbs that would otherwise have been amputated.

The question of the advantages of secondary over primary amputatio has also been discussed in a paper by Horner,* of Philadelphia, where th surgeon advocated the delaying of amputations, founding his opinions upo his own experience with the American army in 1812; and upon those Mann and Trowbridge, also surgeons in the army at that period. Man states that, after the battles of Little York and Fort Greene, a less numb survived primitive than consecutive amputations, three or four dying immediately after the primitive operation, while there was not a single death o casioned by consecutive amputation during the campaign of 1813. Trowbridge gives his testimony in favor of immediate amputation only when the is no prospect of saving the limb. Blandin, in France, as late as 1829, w thought to entertain the same sentiments. Fergusson, in referring† to th former opinions of surgeons in relation to the advantages of primary amp tations over those which are secondary, thinks that modern practitione have been too much guided by the opinions of military surgeons, the m jority of whom have decided in favor of primary amputations; whereas inspection of the valuable tables of Reid, of Manchester, has induced hi to think that the balance is greatly in favor of the delayed or seconda operations, the intermediary being more fatal, however, than the primar He therefore, in revising his personal experience, declares his inclination f delay. Miller‡ also expresses the opinion that secondary amputations civil always prove more successful than they do in military practice, an thinks it due to the superior accommodations and conveniences presented civil cases.

My own experience, which has been considerably varied, is decidedly favo able to the performance of secondary amputations in civil practice, partic larly railroad accidents, as it gives sufficient time to learn whether the inte nal injuries which nearly always accompany the necessity for amputation a not sufficient to destroy life without the performance of the operation. now usually simply check the hemorrhage by pressure; or, if the limb mangled, divide the torn tissues, and leave the further treatment of t wound to subsequent consideration.

I therefore advise the reader to delay the performance of amputation any accident until after reaction is fairly established—that is, until t warmth of the body and a free circulation have returned — and then to etherize the patient fully before the performance of the operation, so as to avoid the shock; but in amputations for gunshot wounds in *civil practice*, or for diseased joints or other similar complaints, I would advise him to wait as long as it is possible, or until hectic fever is fairly established, before amputating, believing that the results of secondary amputations, under these circumstances, will prove to be preferable to the primary; and this opinion is, I think, sustained by the facts cited above.

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* Ranking's Abstract, No. xvii., 1853.

† Pract. Surg. 4th Am. edit. p. 158.

‡ Prin. Surg., 4th Am. edit. p. 632.

SECTION II.

POINTS FOR THE PERFORMANCE OF AMPUTATION.

Amputation of an extremity may be performed either at the **place of election** or at the **place of necessity**, and by a circular, oval, or flap-like incision of the soft parts which are to cover the bone and form the stump.

§ 1.—The Place of Election.

The selection of a spot in which amputation can be most advantageously performed is a point which the character of the limb, the occupation of the patient, and the probable substitute for the limb subsequently to be obtained, must chiefly decide, it being performed either through the shaft of the bone —**continuity**—or through its articulation—**contiguity**—in accordance with the nature of the accident, the character of the artificial support that is to be subsequently worn, or the views of the surgeon either for or against amputations through joints. The general rule for all amputations, where the pecuniary circumstances of the patient admit of his obtaining an artificial limb, is to leave as long a stump as possible, in order to secure a firmer attachment; but when the amputation is to be performed on the leg of a poor man, whose means will compel the use of the common peg or wooden leg, to make the stump comparatively short, or at least within four fingers' breadth of the tubercle of the tibia, in order to prevent its protrusion behind the thigh, when the knee is bent upon the peg.

Surgeons of all countries yet differ widely in regard to the advantages of amputating through a joint in preference to above it, arguing that as every articulating surface is covered by a synovial membrane, this is liable to keep up a secretion, prevent the healing of the flap, and thus form a fistula, and that, as a general rule, many joints present prominences of bone which often can only be covered by the integuments, and that the latter will subsequently sustain friction very badly. These arguments, though very specious, have not been sustained by facts, and the efforts of Syme, and also of the younger surgeons in the United States, have had a tendency to create a doubt as to these objections. When an artificial limb, as an arm or leg, is desired, it will, I think, be found that the increase in the length of the stump, by adding to its motion, more than compensates for any delay in healing the wound, and that it will subsequently have sufficient ability to resist pressure without the creation of ulcers. For the further consideration of this question, the reader is, however, referred to the section on Amputation at the Knee-Joint. "The place of necessity knows no law."

SECTION III.

THE DIFFERENT KINDS OF AMPUTATION.

Three principal methods are employed in incising the soft tissues in an amputation, and they are usually designated as the **Circular**, the **Oval**, and the **Flap** operations.

§ 1.—The Circular Operation.

The **circular** method of operating has been described by all surgeons from the earliest periods, especially from the time of Celsus, though it has been modified so as to guard against a conical stump, or to prevent such a retraction of the muscles as would diminish the amount of covering to the bone. Without specifying these modifications, it must suffice to state that the plan of operating at present generally pursued by the profession, and suggested by Petit, of France, appears to have been adopted with a full knowledge of the views of the surgeons of a preceding period, in respect to the advantages of each, and may therefore be presumed to be the best for the forearm and leg, while that modified by Alanson is the best for the thigh and arm, on account of the round full stump that it forms.

Petit's Operation.—After applying the tourniquet or some other means for arresting the circulation, the skin should then be divided by a circular sweep of the large amputating knife, held with its point well over the limb while the surgeon stoops so that the incision may commence with the heel of the blade, on one side, and terminate with the same point on the other side of the limb. The attachment of the skin to the fascia being then divided, and the skin dissected off so that they can be turned back like the cuff of a coat, the muscles should be incised down to the bone by a second sweep of the knife, at the reverted edge of the skin, taking care not to cut this edge, the division of the fibres which adhere directly to the bone being thoroughly accomplished by two or three shorter cuts. The soft parts being now forced or drawn back by means of a retractor in the hands of an assistant, the bone should be cut transversely across, and the operation completed by tying the arteries and closing the stump, as will be subsequently described.

The necessary instruments may be seen in Plate LXXI.

Remarks.—In the formation of a stump by the circular operation of Petit, the surgeon should be particular in turning back sufficient of the skin and bring the sides of the integuments together vertically or antero-posteriorly, it being desirable always to approximate the integuments in such a manner as to favor the subsequent escape of any purulent collections. In the United States it is the almost universal practice to attempt union by the first intention, and it is under such circumstances that the line of union in a circular operation may become a matter of importance.

An important point, in the practice of every young operator, is to decide the proper amount of integuments necessary to cover the stump, and I therefore advise him to proceed as follows: Take the circumference of the limb with a piece of tape, fold it into five equal parts, and then incise the integuments at the distance of one of them from the point at which the bone is to be sawed across, or make the reverted portion with the divided muscles equal to one-fifth of the circumference of the stump. This calculation is sufficiently free to permit of the ordinary amount of retraction during the healing of the stump.

Alanson's modification of the circular operation will be described in connection with the thigh.

§ 2.—The Oval Method.'

The **oblique** or **oval** form of the flap is the result of such an incision as is made by carrying the knife a little higher on one side of the limb than on the other, so as to form an oval instead of a circular wound, and is especially applicable to amputations through the joints. In performing it the knife should be carried around the limb by two distinct sweeps, and not in one continuous cut, as was done in the circular operation, so that each incision may be carried around half the limb in a direction which is oblique to its perpendicular diameter, thus dividing all the parts down to the bone and forming a wound which will be angular at its point of commencement and termination, but rounded in the intermediate part something like the letter U, when its two ends are brought nearly in contact.

Remarks.—The oval method is seldom applied to amputations of the shaft of the bones, though where there is a large amount of muscle and integument, as in a well-developed thigh or arm, I have found it to form a better stump than the circular method, as it avoids the folds and puckering so generally caused by the approximation of the edges of a circular wound. The selection of the amount of the flaps will be decided as before.

§ 3.—The Flap Operation.

In incising the integuments for the formation of a **flap** to cover the end of the bone, two methods have been employed, the difference being chiefly in the formation of one or two flaps, according to circumstances.

When two flaps are desired, they may be formed either by cutting from the skin to the bone, or from the bone outward.

In operating from without inward, the soft parts are punctured by the catlin, and the cut made on one side through all the tissues from within outward, at an angle capable of furnishing a sufficient amount to form a cushion for the end of the bone. This flap being then held back by an assistant, a second one is formed on the side of the vessels of the limb, by commencing at the bone, and cutting outward, when the latter is to be sawed off, and the flaps approximated.

In the single flap operation, the structures are divided on one side, either with or without other incisions.

The calculation of the amount of integuments requisite to cover the stump, in this method of operating, would be about one-fourth instead of one-fifth, as there is more retraction of the soft parts when they are thus divided.

In 1855, Teale, of Leeds, England, recommended the formation of a long anterior and a short posterior flap, with square ends. The long anterior flap, not including the main vessels and nerves, should be equal in length to one-half the circumference of the limb; two longitudinal lines of this length, measuring from the point where the bone is to be sawed off, being first traced on the limb, and met at their lower points by a transverse line of the same length. The short flap is indicated by a transverse line of the length of one-fourth of the long one—that is, assuming the circumference of the limb to be sixteen inches, the length of the long flap would be eight inches, and the length of the short flap two inches. The two lateral incisions of the long flap should be made *only through the integuments*. The transverse cut of this flap is made by a free sweep of the knife through all the tissues to the bone, and then shaved from the front of the bone and from below upward as high as is necessary. The posterior short flap is to be made by one sweep of the knife down to the bone, the soft parts being afterward separated from the periosteum as far upward—two inches—as the intended place of sawing the bone.[*]

Remarks.—The flap operation is the favorite mode of amputating with some surgeons, on account, apparently, of the rapidity with which it may be performed; but it is especially liable to secondary hemorrhage, owing to the oblique division of the vessels of the stump. Sometimes, however, it is the result of necessity, as in cases of laceration, where the integuments are destroyed on one side of the limb, and a sufficient covering for a stump cannot otherwise be obtained.

§ 4.—Estimate of the Different Kinds of Amputation.

The variety of cases requiring amputation, and the different results obtained under such circumstances, have apparently caused a want of harmony among experienced surgeons in deciding on the merits of either plan, which it is difficult to credit, especially when it is recollected that these opinions are the result of each surgeon's experience. Such a diversity of sentiment is, however, rather apparent than real, and must be ascribed to the predilections consequent on the force of circumstances; thus, an amputation that might be instantly demanded on a field of battle and without assistants, might be performed very differently when the operator was in a civil hospital, and with every convenience, so that, if two surgeons were similarly situated, they would doubtless coincide perfectly on this, as on most other practical points.

The advocates of the flap operation state that it is more prompt, less painful, exposes less to hemorrhage, obtains a rapid cure, and forms a stump well adapted to an artificial limb.

Its opponents contend that it exposes a greater surface for suppuration; that there is greater difficulty in finding the vessels that are to be tied, owing to their being obliquely divided; and that the secondary hemorrhage is therefore more common after the flap than after the circular operation.

The advocates of the circular operation claim that it is most likely to form a good "apple-dumpling-like stump;" that the arteries may be easily found and tied; that secondary hemorrhage is rare; and that, by giving the wound a conical shape, with the bone in the centre, the flesh is placed in the most favorable condition for properly covering the bone and sustaining pressure.

Its opponents object to its slowness, to the pain caused by dissecting back the cuff-like portion of the skin in the operation of Petit when anæsthetics are not employed, and to the excessive and irregular contraction of the various layers of the muscles when transversely divided.

Chelius,[†] from "personal experience, prefers amputation by the circular cut, with the eversion of the skin, believing the advantages ascribed to the flap operation to be groundless."

Velpeau[‡] thinks "too much importance has generally been accorded to the flap operation; that it has many partisans in the dissecting-room, but is seldom resorted to for amputations in the continuity of the limb."

Fergusson,[§] although performing the flap operation most frequently, owing to special circumstances, states "that at the present day more amputations are done by the circular than by the flap operation; and that, fifteen or twenty years back, not one surgeon in fifty ever thought of performing any other;" and he therefore doubts whether the flap can present any special advantages.

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[*] On amputation by a long and a short rectangular flap, p. 35, et seq., by Thos. P. Teale, F.R.C.S. Leeds, 1858.

[†] System of Surgery, by South, vol. iii. p. 652.

[‡] Operat. Surg., by Mott, vol. iii. p. 484.

[§] Practical Surgery, p. 152.

In the United States, Gibson* advocates the circular operation upon the thigh, and the flap in the leg.

Norris† states "that, with very few exceptions, the circular amputation is the operation performed in the Pennsylvania Hospital, union being always attempted by the first intention."

Hayward‡ says "that, in the Massachusetts General Hospital, a large proportion of the amputations were done by the circular method, the flap being adopted only when it was thought likely to afford a better stump."

Buel§ remarks "that, in 49 cases occurring in the New York City Hospital, 24 were performed by the double flap operation, and 25 by the circular method. Of the flap operations, the mortality was 17·66 per cent., and of the circular, only 12 per cent." He, however, thinks that the greater mortality of the flap operation may have been due to the greater proportion of thighs in which it was performed.

Porter, U. S. A., who served in the Mexican war, expresses the opinion‖ that the army surgeons were greatly in favor of the circular operation in Mexico, one of them of extended experience, and who previously advocated the flap operation, changing his opinion and practice on the ground that the stump made by the circular operation was the best; his own opinion is decidedly in favor of the circular method.

Teale recommends his flap operations as furnishing stumps that are better able to support pressure than any other. I have, however, seen trouble from the want of circulation in the anterior flap formed by this method.

Personal experience has long induced me to think that, in attempting to settle this question, there has been too much ascribed to the defects of each method of operating; that the circular operation is the best in the middle of the limb, but that the flap is the best adapted to the articulations; and that the rapidity with which one can be performed instead of the other is owing rather to the practice of such surgeons as confine themselves to one kind of operation than to the superiority of either in respect to time. In some cases, as in laceration, the flap is the only means of forming a covering to the stump without removing a large amount of the limb. But it should always be remembered that the flap exposes the patient to greater risk of secondary hemorrhage than the other methods, either from the oblique division of the end of the artery, or, as I have sometimes seen, from its being punctured or bruised in the transfixing of the soft parts in the first introduction of the catlin. Owing to the beveled edge of this flap, it is also more likely to induce a conical stump.

SECTION IV.

GENERAL MEASURES REQUISITE IN AMPUTATION.

The mere division and removal of the limb being the simplest portion of an amputation, the surgeon should pay special attention to the other measures connected with the operation, as these are mainly conducive to its prompt and fortunate performance. In every important amputation, the duties of the assistants, and the preparatory as well as the secondary steps, should therefore be thoroughly considered.

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* Practice of Surg., vol. ii. pp. 488, 489.

† Am. Journ. Med. Sciences, vol. xxii. p. 359.

‡ Ibid., vol. i. N. S. p. 65, 1840.

§ Ibid., vol. xvi. N. S. p. 38.

‖ Ibid., vol. xxiv. N. S. p. 24, 1852.

§ 1.—Preparatory Measures.

The general preparatory measures required in an amputation are very much the same as those demanded in other operations,* and do not require any further notice, except the caution that they should be made in accordance with the general health of the patient. Thus, one who is to undergo amputation in full health, may be benefited by a moderate loss of blood, while one who was enfeebled by disease, would be killed by the loss of a few ounces. The diet also should be regulated accordingly.

The propriety of employing anæsthetic agents in *amputations*, and their effects upon the subsequent condition of the patient, are questions that, since the general introduction of anæsthetics in operative surgery, have excited considerable interest. They are, however, questions that must now be regarded as settled, thousands having been operated on without the slightest evil, and with marked benefit in the subsequent nervous disturbance. Few circumstances would lead me to amputate, without first inducing perfect anæsthesia. The advocates of the utility of suffering are fast disappearing, or have ceased to promulgate such antiquated notions.

The necessary instruments are shown in Plate LXXI., and should always be kept in complete order for immediate use. The ligatures should be carefully made. At the moment, the bandage and compress should be prepared for the tourniquet, if it is to be employed; the hair shaved off the skin, so as not to interfere with the subsequent dressings; a retractor of muslin or buckskin, cut with one or two tails, so as to protect the soft parts from the saw; and the limb elevated for a few hours previous to the operation, so as to drain it of blood, if the debilitated condition of the patient renders it desirable to prevent the loss of even a moderate amount.

The dressings for an amputation were formerly very varied; but a more enlightened view of the changes in the condition of parts after an amputation has led to a most judicious change. Instead of the spread cerate, Maltese cross, tow, bandages, etc., which were prepared to envelop the stump, many surgeons now resort to the water-dressing, and require, therefore, a few needles and metallic ligatures to make the interrupted suture, a piece of oiled cloth to place under the limb to protect the bed, and sufficient lint or wet cloths to cover the stump and guard it from external irritants.

§ 2.—Duties of Assistants.

Before commencing an important amputation, as that of the thigh, for example, the surgeon should select four capable assistants, and assign to them their special duties: thus, the first may attend to the etherization, and carefully watch its effects; the second control the hemorrhage, either by pressing on the main artery or by the application of the tourniquet; the third support the lower portion of the limb, and be especially careful in holding it steady during the action of the saw, neither raising it so as to bind the instrument, nor depressing it so as to snap and splinter the bone; while the fourth should hand the instruments, attend to retracting the soft parts, so as to protect them from the saw, and tie the arteries as they are picked out by the surgeon. This assistant may also aid in approximating the flaps during the dressing, while the third warms the adhesive strips when they are required.

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* Vol. i. Part i. p. 167.

§ 3.—After-Treatment.

As the general rules for the after-treatment of all operations have been before described, I shall limit this account to such special means as are required in amputations.

The dressing of an amputation may be advantageously performed as soon as the hemorrhage is entirely checked, in the following manner: Cleanse the surface of the stump by gently squeezing on it the water from a sponge, but do not brush it roughly with the sponge; gather together the ends of the ligatures, and bring as many as possible out of the lower angle of the wound. If the stump presents a large surface, it will also prove useful to introduce a small strip of linen at one angle between the edges of the skin, as was the practice of Physick. Then with the needle and metallic ligature make two or three stitches of the interrupted suture, in order to close the skin, placing the first stitch so as to unite the flaps in the centre, adding to these, if deemed useful, two or three strips of adhesive plaster. Place over this a soft linen towel or piece of lint wet with tepid water, and then place the patient in bed, with the limb slightly elevated by means of a pillow doubled under it, and covered by the oil-cloth. The tourniquet may either be left loosely applied around the limb, or kept near the bed ready for use. In order to prevent spasm of the stump, and such muscular contraction as might derange the dressing, a broad bandage should be carried over the limb above the stump, and its ends pinned fast to the bed, after which a hoop should be so arranged as to keep off the weight of the bedclothes. One assistant should then be left on guard for twenty-four hours, and an anodyne administered, if the patient require it.

During the first forty-eight hours after a primary amputation, on a patient in good health, the diet may consist of light nutritious articles, as broths, etc., and then, if fever, or a tendency to active inflammation is not apparent, he may be allowed to eat meat and resume his ordinary diet. But if he has been previously confined to bed by a chronic disease, no change should be made in the diet previously given.

The only attention required by the stump, in many instances, during the first forty-eight or seventy-two hours after the first dressing, is to keep the lint or cloth moist by squeezing upon it water of such a temperature as is most agreeable to the feelings of the patient, some liking it cold and others tepid, the oiled cloth beneath the limb being so arranged as to carry off the surplus water and keep the patient dry. On the fifth day, if ulceration is apparent about the stitches, one or more may be removed, and the flaps supported by long adhesive strips, or by the turns of a bandage; but usually the metallic sutures will retain their position for ten or fifteen days without inducing ulceration. About the sixth or tenth day, one or more of the ligatures will be loosened, and may be quietly drawn away; but, should they adhere too long, and delay the cure, then the means before referred to* should be resorted to. As soon as the ligatures have separated, the stump may be advantageously compressed by the gentle traction of a bandage until the newly-formed adhesions have acquired firmness. When, in the course of the treatment, the stump shows a disposition to high inflammation, *cloths wrung out of hot water*, and then dusted with powdered camphor, so as to place it between two layers, may be substituted, if suppuration seems likely to relieve it; but whenever the latter is freely established, the stump should be placed horizontally, or slightly inclined downward, so as to favor the escape of the matter, and prevent its burrowing in the muscular interspaces. Although the water-dressing, as usually practiced, occasionally presents examples of union by the first intention throughout a considerable portion of the stump, it will not always do so. When, therefore, suppuration is freely established, the wet cloths should be frequently changed and fresh ones substituted, so as to prevent decomposition of the pus and subsequent irritation. By these means, the secretions never become offensive, and both patient and surgeon obtain a degree of comfort that was impracticable under the old method of dressing. When there is a short stump, and a tendency to retraction of the muscles, the application of the bandage and straps, as shown in Fig. 452, will be useful.

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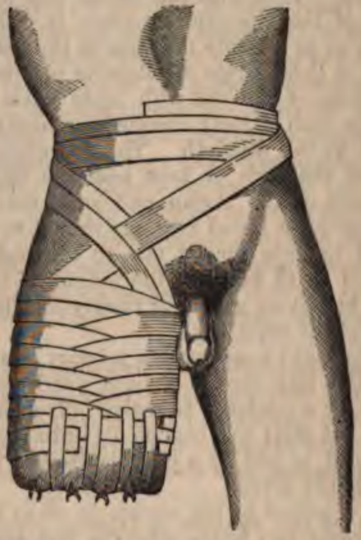
* Vol. i. Part i. p. 198.

Fig. 452.



Dressing of a Stump by Metallic Sutures and Strips attached to a Bandage.

Fouilley, of Brest, has advised that in cases of a short flap, with a marked tendency to retraction, we should resist it by applying several straps of adhesive plaster vertically from a point several inches above the incision in front, to a corresponding point behind, making the straps long enough for their centres to project about four inches *beyond the end* of the stump. Then, running a cord through the loops so as to project beyond the stump made, attach a weight to the cord.

§ 4.—Accidents that may occur either during or after Amputation.

The occurrence of an accident during an amputation is an event which proper foresight will always prevent, and it should therefore be regarded, like many other "accidents," as positive evidence of the carelessness of the operator. This carelessness may be shown: 1. In the occurrence of hemorrhage. 2. In cutting openings in the flaps. 3. In splintering the bone.

The occurrence of hemorrhage during an amputation may arise from breaking the tourniquet, or from failure, by the assistant intrusted with it, to compress the artery; both of which can be avoided by proper care.

The flaps may be cut or perforated, in the circular operation, by careless dissection of the skin, or by thoughtlessly transfixing one point instead of another; while splintering of the bone may arise from want of ability or proper information in the assistant who holds the limb during the act of sawing. Such accidents require merely to be enumerated in order to be avoided. Fainting is the only event truly accidental that can occur during an amputation, and it may be readily remedied by lowering the patient's head, and administering stimulants.

After an operation, hemorrhage may occur at any moment. If it shows itself within forty-eight hours, it is evidence of the neglect of the surgeon in ligating the vessels of the stump; and if not severe, may be checked by compression, but if more profuse, it may be requisite to open the stump and seek for the bleeding vessels, and then ligate them properly.

Spasm, or twitching of the stump, is not an unfrequent occurrence after an amputation, and is due to the irregular contraction of the muscles, sometimes caused by the pressure against the sharp end of the bone, and sometimes due to nervous irritation. Gentle circular compression of the limb, and the free use of opiates internally, will usually afford relief. Should the recurrent bandage of stumps have been applied, the turns should be examined to see that they do not compress the end of the soft parts of the stump against the freshly sawed edge of the bone.

"At Guy's Hospital, for the last two years, Hilton has been in the habit of supporting the stumps of amputated thighs by applying a short and broad splint under the stump, which is elevated at an angle of forty degrees; beneath the splint is a small cushion, and a light bandage is applied over all."*

Inflammation of the stump, abscesses, or exfoliation of a lamina of bone may also complicate the after-treatment; but they may be relieved on the ordinary principles of the treatment of such affections elsewhere. The exfoliation of the bone is often caused by the careless use of the saw lacerating the periosteum and endosteum, and thus separating them from the bone, so as to impair its nutrition.

When the removal of the ligature is delayed beyond the proper time, (three to four weeks,) a resort to the means referred to† is all that is necessary.

Neuralgia of the stump may arise either from the inflammation and enlargement of the end of a nerve, or from its adhesion to the cicatrix. The principles before spoken of in connection with neuralgia will here suffice for the relief of this condition of the part.

A tender condition of the stump, or a constant tendency to ulceration, is sometimes the result of the delicacy of the skin until it becomes accustomed to pressure, and at other times is due to the contraction of the soft parts upon the bone. Under either circumstance the patient will be benefited from soaking the stump daily, for half an hour, in a strong decoction of white-oak bark, which, by acting on the gelatin of the skin, will tan or harden it.

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* London Lancet, 1859.

† Vol. i. p. 198.

CHAPTER VII.

AMPUTATIONS OF THE UPPER EXTREMITY.

In describing the various methods of amputating, I shall chiefly present the methods of the French operators, though, whenever there is occasion, I shall embrace the views of others, while offering the results of individual experience, as tested in daily practice, for nearly thirty years, as well as in the operations of the classes of the University of Pennsylvania upon the dead body.

SECTION I.

AMPUTATION AT THE SHOULDER-JOINT.

Amputation at the Shoulder-Joint is an operation that dates back to a very early period of surgery, being stated to have been performed in the year 1686. From this time it has been more or less frequently repeated, especially by military surgeons, among the most prominent of whom was Larrey, who amputated at the shoulder-joint sixteen times during Napoleon's campaign in Egypt, only losing two cases, and fourteen times after the battles of Wagram and Essling. Subsequently, as stated in his Memoirs, he amputated at the shoulder more than a hundred times, of which ninety cases were cured.

Amputation at the shoulder-joint has also been frequently performed in the United States, having been done by John Warren, of Boston, as early as 1781; by Bayley, of New York, in 1782; and subsequently by Trowbridge, of New York, in 1809; Gibson, of Philadelphia, in 1812; Bowen, of Providence; Whitridge, of South Carolina; G. M'Clellan, six times successfully; and also by Mussey, of Cincinnati; Horner, Randolph, D. Gilbert, and Page, of Philadelphia; N. Pinkney, U. S. Navy; Eve, of Georgia; May, of Washington; J. Mason Warren, of Boston; Sanburn, of Massachusetts; Howard, of Georgia; Pensler, of New York; and Freiott, of Troy. Of these, a large proportion proved successful.

§ 1.—Amputation at the Shoulder-Joint.

The necessity for amputating the arm at its very highest point has in some instances led to its removal above the articulation, though the operation at the shoulder-joint has been much the more common. The latter amputation has been performed by nearly all the known methods of amputating elsewhere, though that of the flap, with its various modifications, has generally been deemed preferable to the circular operation, when circumstances permitted it, owing to the importance of covering the prominence caused by the projection of the acromion process above the glenoid cavity, when the head of the humerus has been removed.

The operation *above* the shoulder-joint may be performed whenever the disorder for which amputation of this extremity is demanded involves either the scapula or clavicle, or both. The following cases illustrate sufficiently such modifications of the ordinary operations at the articulation as have been specially resorted to.

I. **Amputation of the Arm above the Shoulder-Joint.—Operation of Geo. M'Clellan,** of Philadelphia.*—A young man having an encephaloid tumor which extended from the lower part of the right arm upward to the shoulder-joint, and involved the clavicle and scapula entirely within it, the amputation was commenced by securing the subclavian artery just as it emerged from between the scaleni muscles, after which the clavicle was sawn through close to its articulation with the sternum, and the scapula dissected off from the chest so as to permit the removal of the arm with the entire mass, enough sound skin being saved to form a flap front and back. The wound healed readily, and in a few weeks the patient was walking about, but his subsequent condition is not stated.

Operation of Gilbert, of Philadelphia.†—A gentleman with a pancreatic sarcomatous tumor of the shoulder, urgently requiring relief, it was decided, in consultation, to amputate the arm above the shoulder-joint, and remove portions of the clavicle and scapula, which was done as follows:—

The subclavian artery being compressed on the first rib, and an anodyne administered, an incision was made with a large scalpel, commencing at the posterior border of the axilla, and extending upward one inch above the highest portion of the spine of the scapula. The next incision commenced where the first crossed the spine of the scapula, and extended downward and forward to the point of the shoulder, thence upward and inward, along the lower edge of the clavicle, to the extent of its outer third, and then upward above its superior margin, so as to form a triangular flap. This being dissected up, the clavicle, inside of its outer third, was isolated by passing a retractor under it, when the bone was divided by Hey's saw. The skin posterior to the first incision being now reflected backward, the latissimus dorsi and teres major muscles were divided, as well as the infra and supraspinati, beyond the limits of the disease, so as to expose the neck and upper portion of the body of the scapula, after which the spinous process was divided obliquely from behind forward and inward to the neck of the scapula, by means of the amputating saw. The neck and part of the body of the scapula being then sawn through with a long narrow saw, and all the bony connections severed, the skin and pectoralis major muscle were carefully incised from the axilla forward and upward, so as to expose the axillary artery, which being promptly secured, all the remaining attachments were divided, and the wound closed. This patient recovered from the immediate effects of the operation, but died five months subsequently, the axillary lymphatics presenting evidence of the reproduction of the disorder.

II. **Amputation of the Arm at the Shoulder-Joint.**—The following methods are those best adapted to this articulation:—

Lisfranc's Operation.—In this method of operating it is of great consequence that there should be sufficient space behind the patient's shoulder to permit the introduction of the catlin. The patient must, therefore, be either seated or propped up in the bed, so near to its edge that the scapula will be exposed, while the arm should be placed close to the side, in order

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* M'Clellan, Pract. of Surgery, p. 412; note by J. H. B. M'Clellan, M.D., 1847.

† Am. Journ. of Med. Sciences, vol. xiv. N. S. p. 360.

PLATE LXXII.

AMPUTATION OF THE ARM.

Fig. 1. View of the Head of the Humerus, showing its Hemispherical Character. 1. The greater tuberosity. *After Bernard and Huette.*

Fig. 2. A side view of the Bones forming the Shoulder-Joint. 1. The head of the humerus. 2. The clavicle. 3. Acromion process of the scapula. 4. Coracoid process. 5. Dorsum of the scapula. 6. Section of the biceps tendon. *After Bernard and Huette.*

Fig. 3. A Three-quarter view of the Scapula. 1. Glenoid cavity. 2. Spine of the scapula. 3. Coracoid process. *After Bernard and Huette.*

Fig. 4. Lisfranc's Operation for Amputation at the Shoulder-Joint. 1. The long ten-inch catlin transfixing the deltoid muscle from behind. 2. Its point of exit in front. 2, 3, 4. The shape of the posterior flap. *After Bernard and Huette.*

Fig. 5. The same Operation, showing the Formation of the Anterior or Internal Flap. 1. The long catlin. 2. The hand of the surgeon. 3. The anterior angle of the flaps, or point of exit of the catlin. 3, 4, 5. The posterior flap raised up, so as to show (6) the head of the humerus. *After Bernard and Huette.*

Fig. 6. Larrey's Operation for Amputation at the Shoulder-Joint. 1, 2. The first, or vertical incision. 3, 4. The posterior incision, commencing near the middle of the first. 5. The anterior incision, starting from the same point. *After Bernard and Huette.*

Fig. 7. The wound left by the preceding Operation. 1, 2, 3, 4. The shape of the wound. 5. The glenoid cavity. 6, 6. The axillary vessel. *After Bernard and Huette.*

Fig. 8. Velpeau's Flap Amputation of the Arm. 1, 2. The flaps and their relation to the bone, which is shown in the dotted lines. *After Bernard and Huette.*

Fig. 9. The Ordinary Circular Operation for Amputation of the Arm. 1. The knife. 2. The hand of an assistant retracting the soft parts. *After Bernard and Huette.*

Fig. 10. Appearance of the Stump after the Operation. 1, 2. The brachial and profunda arteries. *After Bernard and Huette.*

Plate [illegible]

Fig. 3

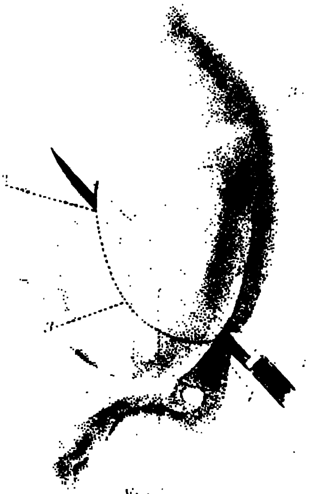


Fig. 1

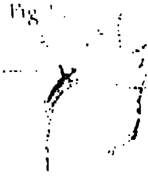


Fig. 2

Fig. 5

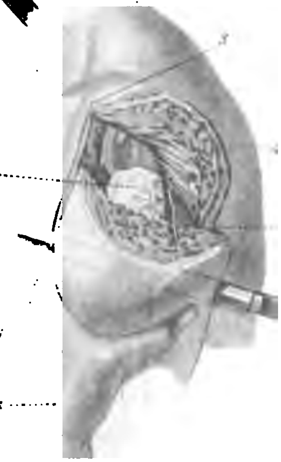


Fig. 6

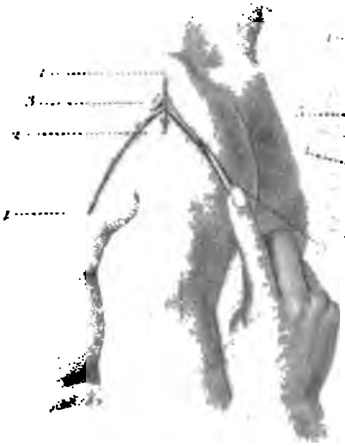


Fig. 7

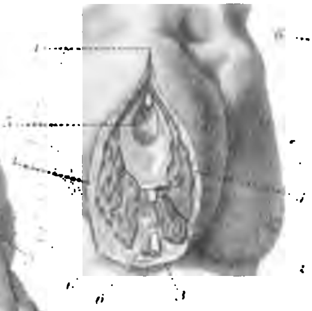


Fig. 9

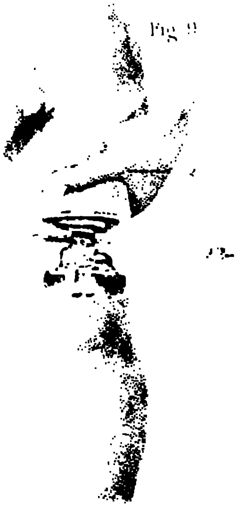


Fig. [illegible]

Fig. 8

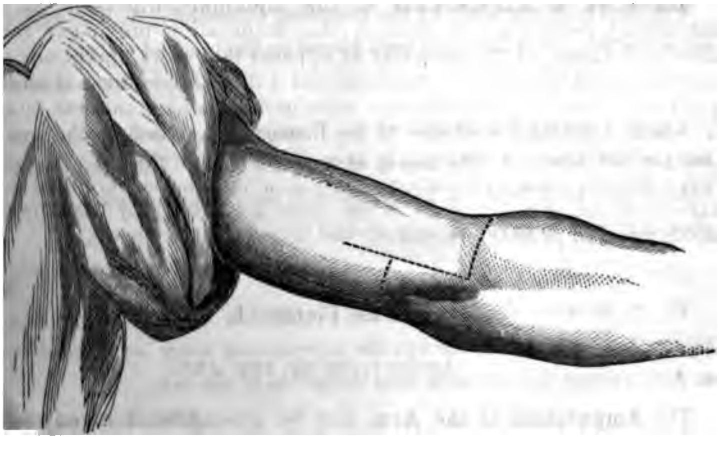
n a suitable position, the tourniquet, or manual compression, should ed to the artery, and the limb carried off from the trunk to nearly a gle with the body, while the surgeon places himself in such a position ive him perfect freedom in his movements. Then, holding the large ing-knife firmly in the right hand, let him grasp the upper part of ent's arm with his left hand, the lower portion being supported by ant, and, stooping down, carry the knife so far round the arm that ommence the incision well on the top of it, the point of the knife ng to his own shoulder. On applying the blade to the skin, let him ide it by one steady circular sweep, by bringing his elbow to his side, ing the knife-handle in his hand, as he sweeps around the limb, so as the heel of the blade to terminate the incision. The looseness of chment of the skin to the fascia permitting considerable motion, it is essary for the assistant to retract it with his hands, Plate LXXII. while the surgeon again, by one sweep and with firm pressure on the vides all the tissues down to the bone. The double-tailed retractor w applied, the bone should be carefully sawed off, any spiculæ that xcised by the bone-nippers, the main artery picked out and tied, and tourniquet loosened, or the compression lessened so as to show the vessels.

emorrhage being thus carefully arrested, the ligatures should be so l that they may be brought out of the angles of the wound, the two which should then be closed and united by one or two sutures, and np—Plate LXXII. Fig. 10—dressed with the cold or tepid water-, according to the season.

d the inflammation of the part, or the effects of disease, have led to ng and adhesions of the skin to the fascia, the former may be turned e the cuff of a coat, before the division of the muscles, as in the cir-putation of the leg.

lap Operation in the arm is the same in principle as that spoken of ection with amputation of the thigh, and is also shown in Plate . Fig. 8.

Fig. 453.



Lines for Teale's operation on the Arm. (After Teale.)

ration.—In operating for the arm, Teale marks out the lines 453, taking care that the inner line of the long anterior flap

that the head of the humerus may be pushed upward and outward as much as possible, by carrying the elbow upward and inward. Then feeling for the acromion and coracoid processes, or for the coraco-acromial triangle, plunge an eight-inch catlin in at the external side of the posterior margin of the axilla above the tendons of the latissimus dorsi and teres major muscles, and carry it across the shoulder, with its blade inclined flatwise, till the point touches the under surface of the acromion process. Then raising the handle sufficiently to lower the point beneath this process, bring it out below the clavicle in the triangular space between the clavicle and the coracoid and acromion processes. Let an assistant now raise the arm from the side, and carry it off from the body, while the surgeon, grasping the relaxed deltoid in his left hand, elevates it as much as possible from the bone, and shaves it off so as to form a posterior semicircular flap about three inches long, Plate LXXII. Fig. 4. This incision should divide the external portion of the capsular ligament and the tendons of the latissimus and teres major and minor muscles, as well as the deltoid; but if the capsule has not been freely divided by the point of the knife passing over it as it was introduced, it may now be effected by incising it with its heel, while the assistant holds up the flap.

On again carrying the elbow a little toward the side, the head of the humerus will escape through the opening in the capsule, when the knife should be passed around it to the inside of the bone, and carried downward and forward, so as to shave off an internal flap of about two and a half inches, Plate LXXII. Fig. 5, the artery which remains in the flap being held by an assistant grasping the flap before it is detached from the arm below.

When operating on the right shoulder, the same steps are taken; but the point of the knife is inserted in front of the axilla at the coraco-acromial triangle, and made to come out behind at the same point as was above directed for its insertion in the left shoulder.

Larrey's Operation.—Amputation of the shoulder by the formation of an oval flap is the method sanctioned by the experience of this well-known surgeon, who had frequent occasion to perform it in his campaigns.

Operation.—Make a vertical incision on the external side of the shoulder, down to the bone, and carry it from the edge of the acromion process to within about one inch of the level of the surgical neck of the humerus. Then, commencing at this point, make two oblique incisions, one anteriorly and the other posteriorly, so as to divide the integuments and flesh on the anterior and posterior parietes of the axilla, as well as the insertions of the pectoralis and latissimus muscles, Plate LXXII. Fig. 6. Push back the edges of this wound, and open the joint by a single cut of the knife, drawing slightly upon the humerus, so as to put the ligaments on the stretch. Luxate the head of the bone, pass the knife behind it, and terminate the operation by dividing the structure in the axilla, in which are found the arteries and nerves, which should, at the moment, be compressed by an assistant. The wound which is left is perfectly oval, and well adapted to healing, Plate LXXII. Fig. 7.

As the injury which demands this amputation is often the result of a lacerated wound which leaves but little choice as to a flap, the following account is cited as illustrative of one course of proceeding under these circumstances:—

Operation of Peaslee, of New York.*—A musket being accidentally discharged into the shoulder, the entire charge passed directly through the arm, entering on the inside just above the insertion of the deltoid; it then passed obliquely backward, upward, and outward, and, emerging directly below the acromion process, after shattering the bone and blowing away several ounces of the deltoid, left a wound capable of receiving an ordinary teacup. Amputation being decided on, and the ordinary methods being impracticable, the operation was performed as follows:—

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* New York Journ. of Med., vol. x. N. S. p. 297. 1853.

Operation.—A catlin was passed through the inner edge of the deltoid muscle at a point two inches below the joint, and brought out at the edge of the external wound so as to form a very small anterior flap; after which the knife was carried through the joint, and a posterior flap made of the skin and triceps muscle by extending the incision nearly to the elbow.

This patient subsequently recovered and had a good stump, the greater portion of which was formed by the skin and triceps muscle being turned up so as to meet the lower edge of the anterior flap nearly on a line with the coracoid process.

Remarks.—As all the plans above stated present excellent methods of amputating at this joint, it is unnecessary to enter into a description of the various modifications that have been proposed by others. The circular operation at this joint presents us with nothing peculiar. Sanson, of Paris, who, in connection with Velpeau, recommended it strongly, divided all the structures at one sweep of the knife, applied one inch below the acromion, and then disarticulated the bone.

The objection to this method of amputating, or rather the advantages possessed by either that of Lisfranc or Larrey over the circular operation, is that, as the artery in the flap is not divided until the last moment, it can then be promptly seized and tied, in consequence of the disarticulation placing the arm out of the way. I believe that this operation is generally preferred by surgeons in the United States.

From the account furnished by Stephen Smith, of New York,* in an excellent paper on amputations of large joints, it appears that amputation at the shoulder-joint has generally been more fatal both in hospital and private practice than amputations of the arm or thigh. He, however, regards the primary as more successful than the secondary amputation at this joint, both in military and private practice.

Statistics of Amputations at the Shoulder-Joint.†—From the same statistics,‡ including the cases of this amputation previously reported by Buel and Lente, of the same city, it appears that of 39 operations performed in the United States, 13 were fatal and 1 doubtful, being a mortality of 33 per cent. In 7 cases anæsthetics were used, of which one was fatal. From a careful examination of the tables formed by collecting the operations of many of the European hospitals, as well as those in New York, Smith therefore concludes that amputation at the shoulder-joint is more fatal than amputations of the arm or thigh in the same hospitals, and that the same rule holds good in private practice.

SECTION II.

AMPUTATION OF THE ARM.

The **Amputation of the Arm** may be accomplished at any point of its length, either by the circular or flap operation.

Circular Operation of Alanson.—The patient being etherized, and then placed in a suitable position, the tourniquet, or manual compression, should be applied to the artery, and the limb carried off from the trunk to nearly a right angle with the body, while the surgeon places himself in such a position as will give him perfect freedom in his movements. Then, holding the large amputating-knife firmly in the right hand, let him grasp the upper part of the patient's arm with his left hand, the lower portion being supported by an assistant, and, stooping down, carry the knife so far round the arm that he can commence the incision well on the top of it, the point of the knife presenting to his own shoulder. On applying the blade to the skin, let him now divide it by one steady circular sweep, by bringing his elbow to his side, and turning the knife-handle in his hand, as he sweeps around the limb, so as to cause the heel of the blade to terminate the incision. The looseness of the attachment of the skin to the fascia permitting considerable motion, it is only necessary for the assistant to retract it with his hands, Plate LXXII. Fig. 9, while the surgeon again, by one sweep and with firm pressure on the knife, divides all the tissues down to the bone. The double-tailed retractor being now applied, the bone should be carefully sawed off, any spiculæ that remain excised by the bone-nippers, the main artery picked out and tied, and then the tourniquet loosened, or the compression lessened so as to show the smaller vessels.

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* New York Journal of Med., vol. x. N. S. p. 15.

† Transactions American Medical Association, and Am. Journ. Med. Sci.

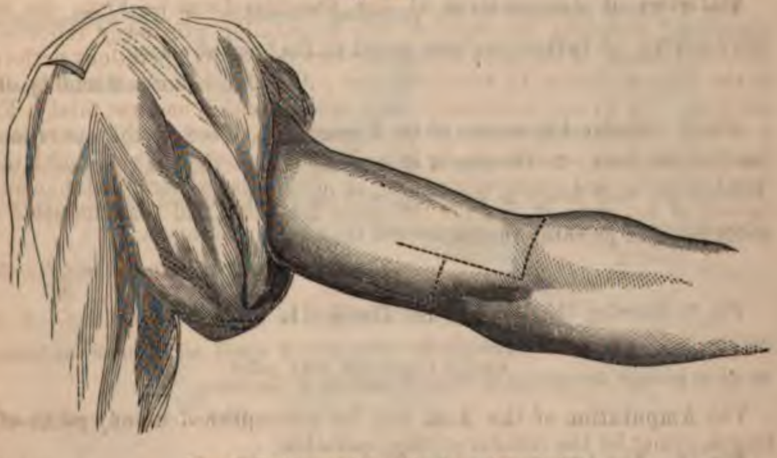
‡ New York Journal of Med., vol. x. p. 9. 1853.

The hemorrhage being thus carefully arrested, the ligatures should be so arranged that they may be brought out of the angles of the wound, the two sides of which should then be closed and united by one or two sutures, and the stump—Plate LXXII. Fig. 10—dressed with the cold or tepid water-dressing, according to the season.

Should the inflammation of the part, or the effects of disease, have led to thickening and adhesions of the skin to the fascia, the former may be turned back, like the cuff of a coat, before the division of the muscles, as in the circular amputation of the leg.

The Flap Operation in the arm is the same in principle as that spoken of in connection with amputation of the thigh, and is also shown in Plate LXXII. Fig. 8.

Fig. 453.



Lines for Teale's operation on the Arm. (After Teale.)

Teale's Operation.—In operating for the arm, Teale marks out the lines shown in Fig. 453, taking care that the inner line of the long anterior flap

PLATE LXXIII.

AMPUTATION AT THE ELBOW-JOINT.

Fig. 1. A front view of the Articulating Surfaces of the Bones composing the Elbow-Joint. 1. The humerus. 2. The radius. 3. The ulna.

After Bernard and Huette.

Fig. 2. A side view of the Elbow-Joint. 1. The humerus. 2. Head of the radius. 3. The ulna. *After Bernard and Huette.*

Fig. 3. A front view of the Elbow-Joint. 1. The humerus. 2. The radius. 3. The ulna. 4. The external condyle. 5. The internal condyle. 6. Articulating surface of the radius. 7. Articulating surface of the ulna.

After Bernard and Huette.

Fig. 4. Amputation at the Elbow-Joint by the Flap Operation. 1, 2, 3. The shape of the anterior flap. *After Bernard and Huette.*

Fig. 5. Continuation of the same Operation. 1, 2, 3. The anterior flap turned upward. 4. The knife in the act of completing the division of the anterior ligament of the joint. 5, 6, 7. Shape of the surface from which the flap has been cut. *After Bernard and Huette.*

Fig. 6. Velpeau's Circular Operation at the Elbow-Joint. 1, 2. Fold of integuments turned up, showing the knife dividing the capsular ligament.

After Bernard and Huette.

Fig. 7. The Wound left by the preceding Operation. 1. The epitrochlea of the humerus. A ligature has been placed on the brachial artery.

After Bernard and Huette.

Fig. 8. Circular Amputation of the Forearm. 1. Hand of assistant retracting the soft parts. 2. The flap of skin turned back. The hand of the surgeon holding the knife firmly in its grasp, with the point inclined to the surgeon's shoulder, so as to sweep entirely around the arm, is also shown.

After Bernard and Huette.

Fig. 9. Showing the Bones of the Forearm in the same Operation. A retractor has been passed through the interosseous space and around the bones, so as to protect the soft parts from the action of the saw.

After Bernard and Huette.

Fig. 10. The Appearance of the Wound after a Circular Amputation of the Thigh. 1. The femur. 2, 2. The arteries. *After Bernard and Huette.*

Plate 78

Fig. 1

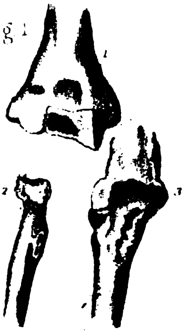


Fig. 2

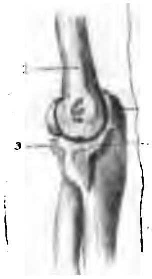


Fig. 3

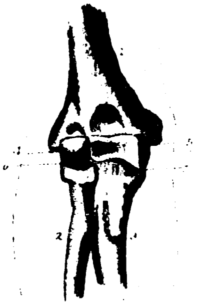


Fig. 4

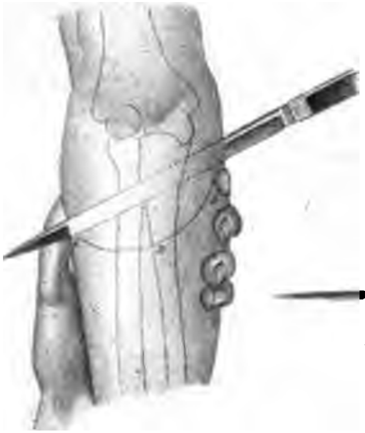


Fig. 5

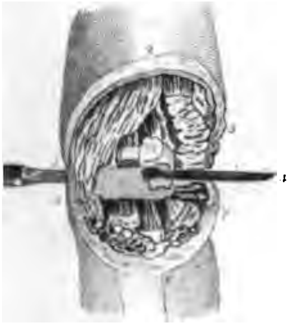


Fig. 6

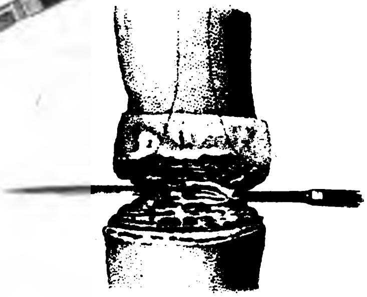


Fig. 8

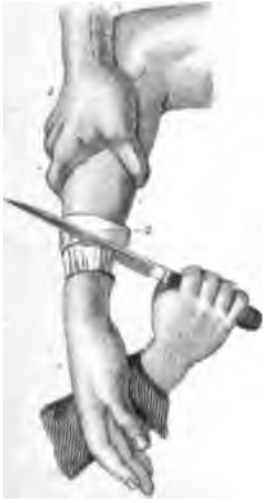


Fig. 7

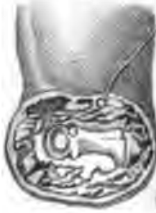


Fig. 9

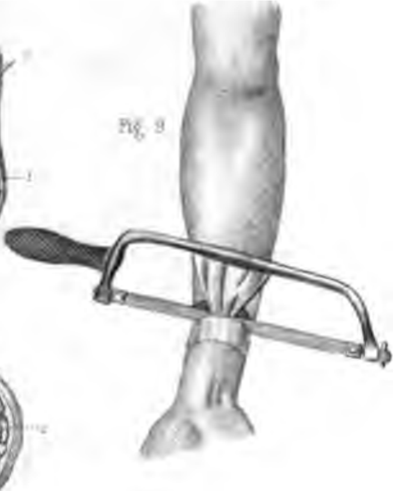
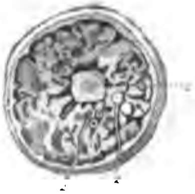


Fig. 10



[illegible]

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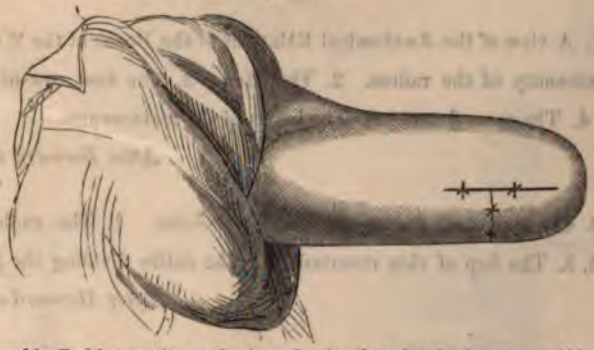
[illegible]

should fall as near as possible to the brachial artery without including it in this flap. After sawing off the bone and arresting the hemorrhage, bring the flaps together and unite them by metallic sutures as shown in Fig. 454.

Fig. 454.



Stump formed by Teale's operation on the Arm, showing the points for the sutures. (After Teale.)

Remarks.—The results of amputations of the arm are among the most favorable of those presented in connection with amputations, death being a rare exception in the success attendant on this operation. Teale's operation forms a good stump, but Alanson's is a better operation where it can be done.

SECTION III.

AMPUTATION AT THE ELBOW-JOINT.

Amputation at the Elbow-Joint, like amputation at the knee, has long been considered by surgeons as an objectionable operation, from the fact that the condyles and epitrochlea of the humerus, owing to their prominence and irregular form, were thought to be badly adapted for sustaining pressure, while the continued secretion of synovia it was supposed would be likely to keep the wound open some time. Although these objections are by no means accurately proved in relation to amputations through the articulations generally, yet, as there is nothing gained in a disarticulation of the elbow over an amputation immediately above the joint, the operation has not been frequently performed. Originally suggested by Ambrose Paré, in 1580, it has been repeated by several European and American surgeons, among the latter of whom were James Mann, of Connecticut, in 1812, and Kearny Rodgers, of New York, in 1827. Mann, in his operation, created double flaps, and Rodgers antero-posterior flaps. The circular operation has also been performed by Velpeau, of France, and the oval method by Textor, of Germany.

I am satisfied, from a careful examination of American surgical works and journals, that, with the exception of the cases above mentioned, this amputation has seldom been repeated in the United States; and in furnishing an account of the methods by which it may be accomplished, I desire rather to complete the enumeration of surgical operations than to be regarded as recommending this one. Velpeau's operation was performed as follows:—

Velpeau's Operation.—The hand being strongly supinated, and the forearm slightly flexed, a circular cut is to be made through the integuments about three fingers' width below the bend of the elbow; then, dissecting up

PLATE LXXIV.

AMPUTATION OF THE HAND.

Fig. 1. A view of the Anatomical Relations of the Bones of the Wrist. 1. The lower extremity of the radius. 2. The ulna. 3. The first row of the carpal bones. 4. The second row. 5. The bones of the metacarpus.
After Bernard and Huette.

Fig. 2. Circular Amputation at the Wrist-Joint. 1. The radius. 2. The ulna. 3, 3. The flap of skin reverted. 4. The catlin dividing the front of the joint. *After Bernard and Huette.*

Fig. 3. Denonvillier's Operation at the Wrist. 1. The radius. 2. The ulna. 3. The semicircular incision on the back of the wrist. 4. The knife about to cut a flap from the palm of the hand. *After Bernard and Huette.*

Fig. 4. The Stump after the preceding Operation. " " "

Fig. 5. Maingault's Operation for Amputation of all the Metacarpal Bones, except that of the Thumb. 1, 2, 3. The anterior flap. 4. The knife, which, having transfixed the palm, is about to cut the flap. *After Bernard and Huette.*

Fig. 6. Completion of the same Operation. 1, 2, 3. The posterior section. 4. The knife incising the joint. *After Bernard and Huette.*

Fig. 7. Disarticulation of the Thumb. 1, 2, 3. Line of the incision so as to form an oval wound. *After Bernard and Huette.*

Fig. 8. The Thumb, being carried across the Palm of the Joint, is opened on its External Side. 1. The head of the metacarpal bone. 2. The bistoury.
After Bernard and Huette.

Fig. 9. Union of the Wound, showing the Line of the Cicatrix and the Appearance of the Hand after the Amputation. *After Bernard and Huette.*

and reverting this flap, Plate LXXIII. Fig. 6, cut through the muscles at one sweep, divide the lateral ligaments, open the joint in front, and then divide the triceps tendon above the olecranon process. The main trunk of the brachial is the principal artery to be tied, after which the wound can be readily closed by uniting the skin transversely.

Flap Operation.—The circular amputation of this joint is by no means the best method of forming a stump. As the muscles of the forearm are chiefly developed in front of the elbow-joint, I should prefer the flap operation by the following plan :—

Operation.—Place the forearm in a semiflexed position, and, grasping the muscles of the forearm in the left hand, raise them, and pass an eight-inch catlin through, so as to shave the bones immediately in front of the coronoid process, and cut an oval flap about four inches long; then passing the catlin rapidly round the back of the elbow, just on a line with the upper edge of the olecranon process, connect this incision with the point of entrance and exit of the catlin. On dividing the back of the capsule and the tendon of the triceps, cut the internal and external lateral ligaments, and, reverting the front flap, divide the front of the capsule of the joint, remove the limb, and unite the flap on the back of the arm, above the line of the condyles, by the interrupted suture.

Remarks.—I have often amputated in this way upon the subject, and obtained a good covering for the end of the humerus, though I know of no case in this country in which the operation has been thus performed on the patient.

SECTION IV.

AMPUTATION OF THE FOREARM.

In Amputation of the Forearm, every effort should be made to preserve as great an amount of the member as possible, in order to facilitate its subsequent usefulness, whether the patient contemplates using an artificial limb, or merely a hook.

This amputation may be best accomplished by the ordinary circular method, as directed in the amputation of the arm, Plate LXXIII. Fig. 8, a retractor of two tails being prepared, in order to protect the parts more effectually; one tail being passed through the interosseous space, Plate LXXIII. Fig. 9.

The flap operation is also applicable to this member, but does not form so good a stump when the amputation is required at the lower third of the arm. At its upper third it may be performed by forming a flap anteriorly and posteriorly out of the thickness of the flexor and extensor muscles. The circular operation at the wrist-joint forms a good stump, Plate LXXIV. Fig. 2, and should be performed in preference to the amputation at the upper third of the forearm whenever the injury is confined to the hand.

Remarks.—Whatever method is selected for the performance of the amputation of the soft parts in the forearm, it is necessary to avoid sawing the bones, except when they are perfectly parallel. If the hand is either pronated or supinated while the saw is employed, one bone or the other will be liable to protrude through the stump, create ulceration, or lead to a conical stump. In this, as in all other amputations of the upper extremtieis, it is important to leave the stump as long as possible, as every inch of the upper extremity is valuable.

PLATE LXXV.

AMPUTATION OF THE FINGERS.

Fig. 1. Amputation of all the Fingers at once. 1, 2, 3. The semicircular line of incision over the metacarpo-phalangeal articulations. 4. The catlin about to form flaps from the palmar surfaces of the four fingers.
After Bernard and Huette.

Fig. 2. The Stump after the preceding Operation. 1, 2, 3. The palmar flap.
After Bernard and Huette.

Fig. 3. A Circular Amputation through the Metacarpal Bones. 1, 1. Retractors passed between each bone. 2. The saw in the act of dividing them.
After Bernard and Huette.

Fig. 4. Disarticulation of the Metacarpal Bone of the Little Finger by the Oval Method. 1, 2, 3. The line of the incision. *After Bernard and Huette.*

Fig. 5. Amputation through the Fifth Metacarpal Bone. The bone has been sawed through obliquely, while a compress protects the soft parts.
After Bernard and Huette.

Fig. 6. Appearance of the Cicatrix after the Operation of Fig. 4.
After Bernard and Huette.

Fig. 7. Disarticulation of a Finger by the Oval and Flap Operations. *Little finger*, 1, 2, 3. Wound left by the oval method. *Middle finger*, 1, 2, 3. Wound left by the flap operation. *After Bernard and Huette.*

Fig. 8. The Anatomical Relations of the Palmar Surface of the Phalanges of a Finger. 1. The metacarpal bone. 2. The first phalanx. 3. Its lower extremity. 4. Second phalanx. 5. The third phalanx. *After Bernard and Huette.*

Fig. 9. Relations of the Flexor Tendons to the Bones. 1, 1, 1. The three phalanges. 2. Tendon of the flexor sublimis. 3. Tendon of the flexor profundus.
After Bernard and Huette.

Fig. 10. A side view of the Relations of the Bones of a Finger, when flexed, as in Amputation at the Joints. *After Bernard and Huette.*

Fig. 11. Lisfranc's Amputation of the Phalanx of a Finger at the Joint, showing the position of the finger and the knife in the first incision.
After Bernard and Huette.

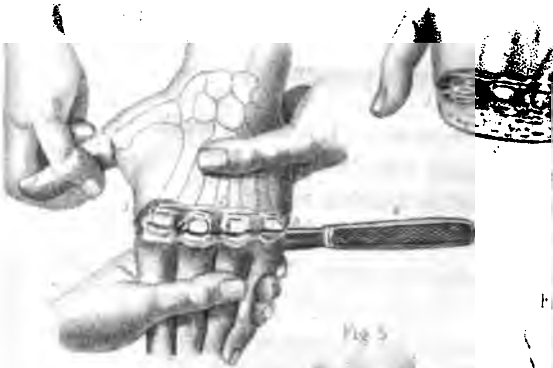
Fig. 12. The same Operation. A flap is about to be formed from the palmar surface of the finger. *After Bernard and Huette.*

Fig. 13. Palmar view of Lisfranc's Operation, when it is commenced on the Front of the Finger. 1, 2, 3. The flap. *After Bernard and Huette.*

Fig. 14. The flap turned up to show the Disarticulation. " "

Figs. 15, 16, 17. Different Stumps resulting from the flap, oval, and circular operations. *After Bernard and Huette.*

Fig 2



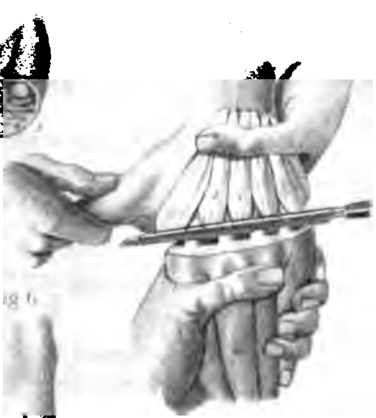


Fig 6

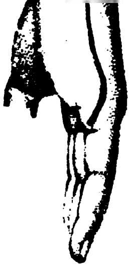


Fig 4

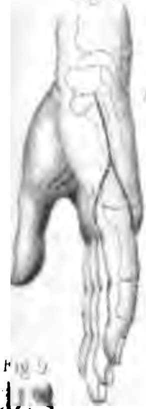


Fig 5

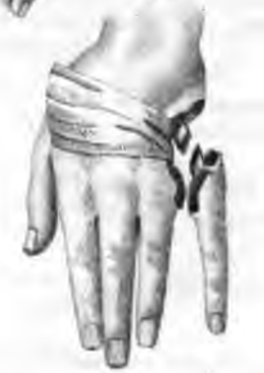


Fig 7

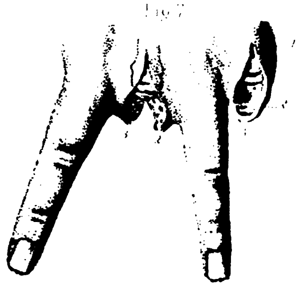


Fig 8

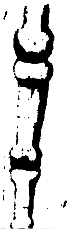


Fig 9

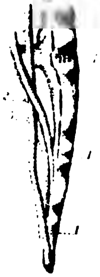


Fig 12

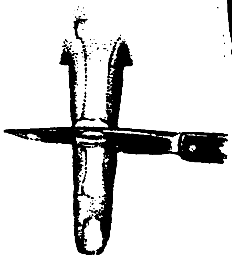


Fig 10

Fig 11

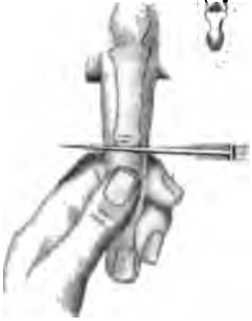


Fig 13

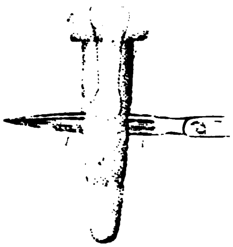


Fig 14

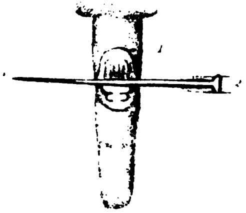


Fig 15

Fig 16

SECTION V.

AMPUTATION OF THE FINGERS.

Amputation of the various **Phalanges** may be accomplished either by the flap, oval, or circular methods, and is sufficiently explained in Plate LXXV.

The flap method, by the plan of Lisfranc, Plate LXXV. Figs. 11, 12, is generally the best for an amputation at the different articulations of the phalanges with each other; the circular is best adapted to the operation through the body of each phalanx; and the oval to the removal of the finger at the metacarpo-phalangeal articulation, as shown in Plate LXXV. Fig. 7. As the plate exhibits these operations very clearly, a detailed description is here unnecessary.

CHAPTER VIII.

AMPUTATIONS OF THE LOWER EXTREMITY.

Amputation of the Lower Extremity requires the observance of nearly the same general rules as have been detailed under the head of amputations in general. The necessity for the preservation of as great a length of limb as possible is also absolute in this extremity, except when the amputation is to be performed on the leg, and the patient anticipates wearing the common wooden leg or peg. Under these circumstances, the limb should not be taken off *at more* than four fingers' breadth from the tubercle of the tibia, as a greater length of stump would incommode the patient, in consequence of its protruding behind the perpendicular line of the opposite limb in walking.

Amputation of the lower extremity may be performed either at its different articulations or in the continuity of the bones.

SECTION I.

AMPUTATION AT THE HIP-JOINT.

Amputation of the Thigh in its contiguity, or by disarticulating the head of the bone, has occasionally been practiced; but, as it generally leaves a large suppurating surface, and a stump upon which it is exceedingly difficult to apply an artificial limb, it should not be resorted to if it is possible to remove the disease by an amputation high up through the *shaft* of the bone, and without disarticulating it.

This amputation was first suggested by the elder Morand, and brought to the notice of the French Academy of Surgery in 1739, though not performed until 1748, when La Croix operated at the Hôtel-Dieu of Orleans, in France, in a case of gangrene which had severed the limb, with the exception of the round ligament of the femur.*

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* Chelius, by South.

In the United States, it was first performed by **Brashear**, of **Kentuc** —since of New Orleans—in 1806,* and by **Mott**, of **New York**, in Octo 1824,† by disarticulating the bone after ligating the femoral artery. It since been performed by Brainard, of Chicago,‡ in 1837; by Buel, of York, in 1847; by Lente, of New York, in 1849; by Van Buren, of York,§ in 1850, in a case in which the shaft of the femur had been previo amputated; by May, of Washington;‖ by Richards and Clagget, of M land,¶ in 1851; by Bradbury** and Fuller, both of Connecticut, in 18 and by Clark, of Detroit,†† in 1853; Buchanan, of Nashville, and m others. Of these 13 cases, 9 were cured and 4 died; 8 of the cases w flap operations, 1 circular, and 4 not described.

Of the various methods of operating, the flap and oval are the best; circular being objectionable on various grounds. When the flap operat can be attempted, the method by the formation of one flap, as shown Plate LXXVI. Figs. 2, 3, will prove the best. In either case, h ever, it is essential that the anatomical relations of the articulations sho be kept distinctly in view by the operator. Although these are figured Plate LXXVI. Fig. 1, in connection with the bones, yet the necessit accurately establishing the position of the head of the femur before the fl are formed, is so important that the following measurements, as furnished Lisfranc, may well be carefully studied. Having tested them a great nu ber of times, I can bear my testimony to the correctness of this, as well the other excellent data furnished by this well-known surgeon.

§ 1.—Surgical Anatomy of the Hip-Joint.

The following indications of the position of the hip-joint having b furnished by Lisfranc,‡‡ and repeatedly tested by others, may be relied on accurate:—

"1st. Let fall from the anterior superior spinous process of the iliu perpendicular line one inch and five lines long, and you will find the ext nal and anterior face of the joint half an inch inside of its extremity.

"2d. Let fall from the anterior inferior spinous process of the iliu perpendicular line half an inch long, and its extremity will correspond to upper part of the joint.

"3d. Draw a line transversely outward for two inches from the spin process of the pubis, and drop a perpendicular line a quarter of an i long from its extremity, and it will fall directly on the joint."

§ 2.—Amputation at the Hip-Joint.

The following cases will illustrate the methods of amputating that may pursued at this articulation:—

Lalouette's Operation.§§—The patient lying on the sound side, make semicircular incision from the upper and external part of the great trochanter to the tuberosity of the ischium, so as to divide all the soft parts down to the joint. On recognizing the articulation, direct the assistant to rotate the limb inward, so as to cause the external surface of the capsular ligament to be put upon the stretch, and then with a strong bistoury or the knife divide the posterior and external face of the capsule, as well as the round ligament; flex the thigh strongly on the abdomen, so as to disarticulate the head of the bone, traverse the front of the joint with the knife, and, passing along the internal side of the thigh, cut a flap on its inner side, four or five inches long, Plate LXXVI. Fig. 3, the artery being compressed in the flap, or upon the bones of the pelvis by the hand of an assistant. After checking the hemorrhage, bring the flaps together, and let the ligatures come out below, unite the skin by a stitch or two, and then apply adhesive strips, a compress and firm bandage, in order to facilitate the union of the deeper-seated parts.

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* Trans. Am. Med. Association, vol. iv. p. 269, 1851.

† Phil. Journ. Med. and Phys. Sciences, vol. xiv. or v. N. S. p. 107, 1837.

‡ Am. Journ. Med. Sciences, vol. xxii p. 37, 1838.

§ Trans. of New York Academy of Medicine, vol i. p. 123.

‖ Am. Journ. of Med. Sciences, vol. xxii. N. S. p. 313.

¶ Trans. Am. Med. Association, vol. iv. p. 270.

** Boston Med. and Surg. Journal, vol. xlvi. p. 349.

†† Peninsular Journ. Med, vol. i. p. 59, 1853.

‡‡ Malgaigne's Op. Surg. Philad. edit. p. 264.

§§ Ibid., p. 266.

Operation of Van Buren, of New York.*—Having amputated the thigh two years previously, near its middle, in consequence of the formation of a "true osteo-cartilaginous exostosis," and the disease having subsequently returned, Van Buren advised amputation at the hip-joint, to which the patient consented.

Operation.—The patient, being in a perfect state of anæsthesia through the influence of chloroform, was placed upon the table, with the buttocks projecting over the edge, the diseased limb held by an assistant previously instructed as to its management, and the other limb and scrotum being held out of the way, the artery was firmly compressed against the pubes.

The surgeon, having now placed himself on the outer side of the limb, seizes it near its middle with his left hand, with the long ten-inch catlin in his right hand transfixes the hip by entering the knife about one inch above the great trochanter, grazing the head and neck of the femur, if possible, as it passes in front of it, and then pushes its point through the integuments near the anus, at a point diametrically opposite to its point of entrance, so as to cut an anterior flap at least six inches long. The first assistant should now pass one hand into the wound behind the knife, and grasp the flap, and with it the artery, carrying the flap forcibly upward with both hands over the groin, Plate LXXVI. Fig. 7. The surgeon, then kneeling a little, should carry the knife to the inner side of the thigh, taking care not to injure the neighboring parts with its point, as it is carried round, and, placing the heel of the knife on the integuments at the internal angle of the wound, Plate LXXVI Fig. 7, carry it across the tissues on the back of the thigh, down to the bone, so as to join the opposite angle of the anterior incision. The catlin being now laid down, the femur should be forcibly abducted, and the capsule of the joint opened by a strong and large scalpel, as near as possible to the acetabulum; the round ligament and the rotator muscle near the trochanter divided, and the limb removed. A large compress or folded towel being then immediately applied to the surface of the posterior flap by the assi tant who lays down the amputated limb, the arteries are to be secured in detail, the gluteal and ischiatic being tied before the femoral and profunda if the latter are well controlled in the anterior flap. The wound is then closed, as before directed.

Operation of May, of Washington.†—The patient, being in a state of complete anæsthesia from chloric ether, was laid on a narrow table, so that the nates projected well over its edge, when the artery was compressed upon

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* Trans. New York Academy of Medicine, p. 135.

† Am. Journ. of Med. Sciences, vol. xxii. N. S. p. 315.

PLATE LXXVI.

AMPUTATION AT THE HIP-JOINT.

Fig. 1. Anatomical Relations of the Bones forming the Joint, together with the Position of the Artery. 1. The iliac fossa. 2. The shaft of the femur. 3. Position of its head in the joint. 4. The external iliac artery. 5, 6. Anterior, superior, and inferior spinous processes. 7. Trochanter minor of the femur. 8. The ischium. 9. The pubis. *After Bernard and Huette.*

Fig. 2. Amputation at the Hip-Joint by the Flap Operation. 1, 2, 3. The anterior flap. 4. The long catlin about to cut the anterior flap. *After Bernard and Huette.*

Fig. 3. Amputation at the Hip-Joint by Lateral or External and Internal Flaps. 1. The long catlin transfixing the limb directly behind the head and neck of the femur. 2, 3, 4. The line of the external flap. 2, 5, 6. The line of the internal flap. *After Bernard and Huette.*

Fig. 4. Continuation of this Operation, when it only remains to disarticulate the Bone. 1, 2, 3. The external flap. 4. The internal flap. 5. The femur. The position of the vessels is shown by the ligatures. *After Bernard and Huette.*

Fig. 5. Continuation of the Flap Operation, as shown in Fig. 2. 1. Hand of an assistant raising the anterior flap. 2. The head of the femur disarticulated. 3, 4. The arteries as tied. 5. A compress protecting the scrotum and opposite thigh. 6. The long catlin, which, after dividing the capsular ligament, is about to shave the posterior flap from the bone. *After Bernard and Huette.*

Fig. 6. Appearance of the Wound left in the preceding Operation. 1, 2, 3. Line of the anterior flap, as reverted upward in order to show the position of the vessels, as well as the acetabulum. 1, 3, 4. The posterior flap. 5. The acetabulum. *After Bernard and Huette.*

Fig. 7. Van Buren's Operation for Amputation at the Hip-Joint by the formation of an Anterior Flap in front and a Circular Incision behind, so as to diminish the time required in the formation of two flaps by the withdrawal of the catlin. 1. The right hand of the surgeon. 2. The position of the catlin in the posterior or circular incision. 3. The left hand of the surgeon abducting the thigh, so as to disarticulate the bone. 4. Hands of the first assistant holding up the anterior flap, and compressing the artery in it. 5. Hands of the second assistant. *After Van Buren.*

Plate [illegible]

Fig.

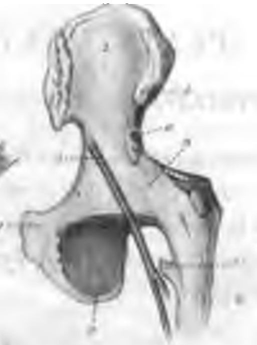


Fig. 1.

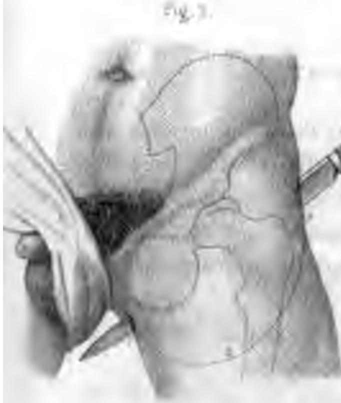


Fig. 3.

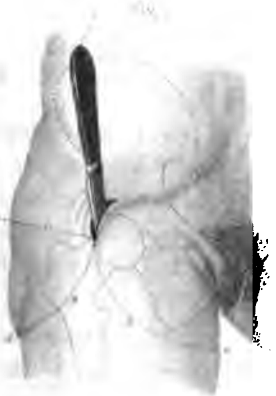


Fig. 4.

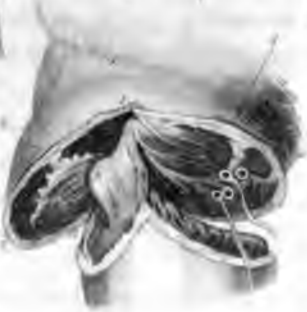
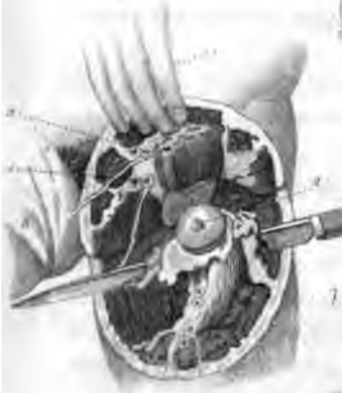


Fig. 5.



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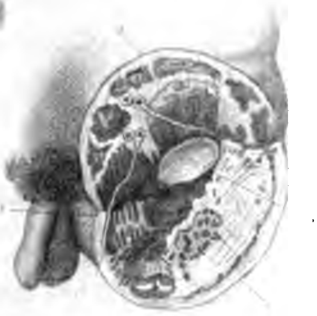
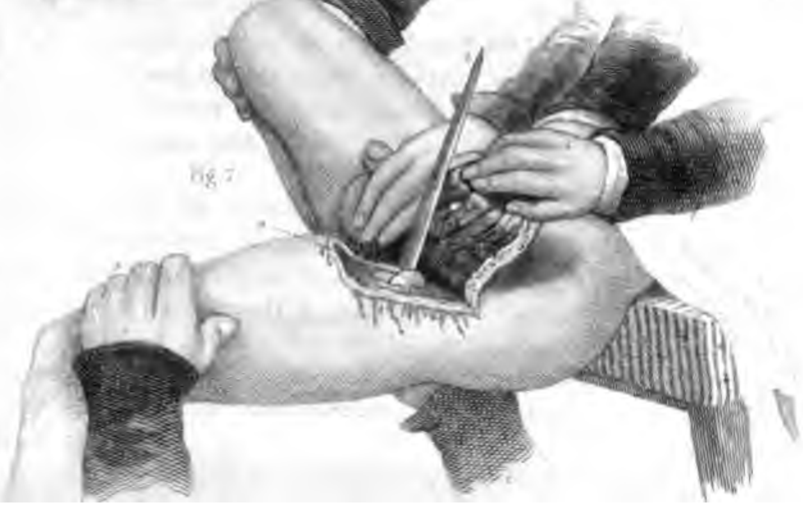


Fig. 7.



the pubis by the thumb of an assistant. The limb being then slightly raised and flexed upon the pelvis so as to relax the muscles on the anterior and upper part of the thigh, the testicles were drawn out of the way, and the sound limb separated as far as possible. The long catlin (ten inches) being then introduced a little above the tuberosity of the ischium, was carried as near as possible to the neck of the femur and brought out one inch and a half below the anterior superior spinous process of the ilium, so as to cut a flap downward from the front of the thigh by shaving it from the bone, the femoral vessels not being divided until the lower edge of the flap was being cut, when they were grasped in the flap above the knife by the hand of an assistant. This flap being now raised and drawn forcibly upward, the femoral artery was still so securely held that scarcely a drop of blood escaped from it. The thigh being then abducted and forcibly depressed by the assistant, the head of the femur was thrown forward, and as much out of the acetabulum as possible, when the capsular ligament was freely divided, and the round ligament and the head of the femur being thrown out of the acetabulum, the knife was passed behind it, and a posterior flap cut a little longer than the anterior one. As soon as the limb was removed, the vessels in the posterior flap were compressed by sponges until they were separately ligated, when the femoral, profunda, and other branches in the anterior flap were secured, twelve arteries in all requiring the ligature. The flaps being then united by four points of the twisted suture, owing to their great weight, adhesive strips covered by the water-dressing were applied to the wound. Not more than eight ounces of blood were lost, and the operation only occupied about thirty seconds, the patient being entirely unconscious until placed in bed.

As illustrative of the suppuration in this extensive amputation, May estimates the discharge in twenty-four hours as equal to half a pint, yet the patient was able to move about in five weeks after the operation. The diet throughout was good: thus, the next day after the operation, he took a little beef-steak for dinner, with coffee, and tea and toast for breakfast and supper; on the second day, stewed oysters; third day, chicken-soup and chicken; fourth day, half a pint of oysters; fifth day, roasted chicken and potatoes; sixth day, half a pint of stewed oysters and potatoes; eighth day, brown-stout; ninth day, beef-steaks, etc. At the same time he took iron and opiates.

Remarks.—This operation is a slight modification of Beclard's, the catlin being introduced from the tuberosity of the ischium and brought out near the anterior superior spinous process instead of the reverse, and in some cases may prove more convenient. It is important in an amputation like that of the hip-joint, where a very free suppuration is to be anticipated, that it should be remembered that the diet and treatment are to be of the most invigorating kind, unless fever or violent inflammatory symptoms supervene.

Various modifications of the amputation at the hip-joint have been from time to time suggested, among which is that of Ashmead, of Philadelphia, in which flaps were formed by cutting from the surface inward, and then disarticulating the bones. But I prefer the method of Lalouette to all of them, when circumstances permit it, as the hemorrhage can be more readily and coolly arrested by tying the vessels in the outer incision before dividing those in the flap formed on the inside of the limb. The surface of the flap is also well adapted to closing up the acetabulum and covering the surrounding bony structures. But when this plan is not available, I would select the lateral flaps either by Beclard's method, or by that of May. In a case reported by Buchanan, of Nashville, the patient returned to his home on the twenty-ninth day.*

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* Amputation of Hip-Joint, by A. H. Buchanan. Nashville, 1859.

PLATE LXXVII.

AMPUTATIONS OF THE THIGH.

Fig 1. The Circular Operation. 1. The knife dividing the muscles. 2. T hand of an assistant favoring their retraction, and holding back the skin. The hand of another assistant compressing the femoral artery when the tour quet is not employed. 4. The circular incision in the integuments. The p spective of this line is slightly misrepresented in the drawing.

After Bernard and Hue

Fig. 2. Amputation of the Thigh by the Double Flap Operation of Sedill 1. The tourniquet applied on the artery. 2. The long catlin about to form t second flap. 3. Hand of the surgeon grasping the soft parts, and drawing th off from the bone. 4. First or exterior flap, as cut from the centre of the thi outward. 5, 6. The line of incision for the inner flap.

After Bernard and Hue

Fig. 3. Sawing the Bone in the Circular Operation. 1. A retractor prote ing and retracting the soft parts. 2. The large amputating saw.

After Bernard and Hue

Fig. 4. Amputation through the Knee-Joint by the Flap Operation. 1, 2, The line of anterior incision. ***After Bernard and Hue***

Fig. 5. Circular Amputation through the Knee-Joint. 1, 2, 3. The line of t incision below the joint. 4. The integuments turned back. 5. The knife op ing the joint in front. ***After Bernard and Huet***

Fig. 6. Amputation by the Oval Method. 1, 2, 3. The line of the incisi below the joint. 4. The flap reverted. 5. The knife disarticulating the bon

After Bernard and Huet

Fig. 7. Continuation of the Flap Operation as commenced in Fig. 4. 1, 2. The line of incision for the formation of the posterior flap. 4. The front the condyles of femur. 5. The catlin. 6. The hand of the surgeon holding t tibia so as to favor the formation of the flap. *After Bernard and Huet*

Plate 77

Fig.1.

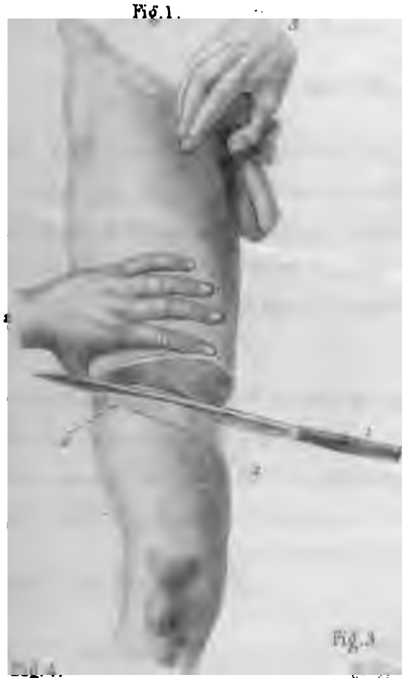


Fig.2.

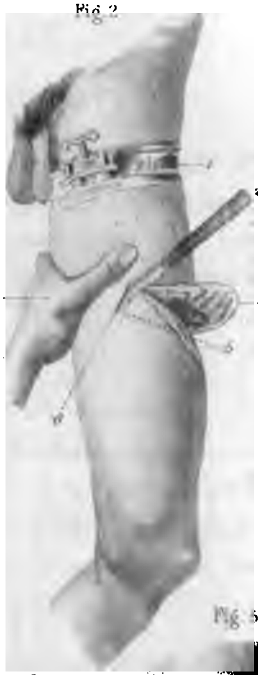


Fig.4.

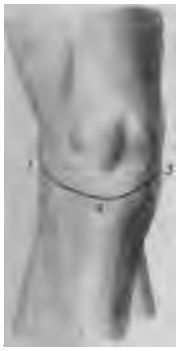
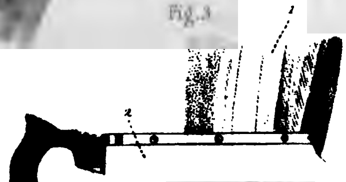


Fig.3



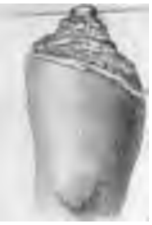


Fig.5.

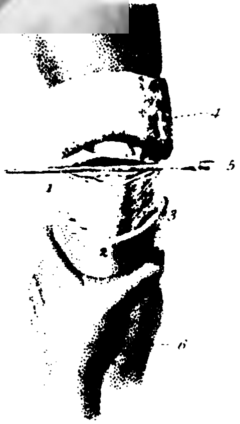


Fig.6.

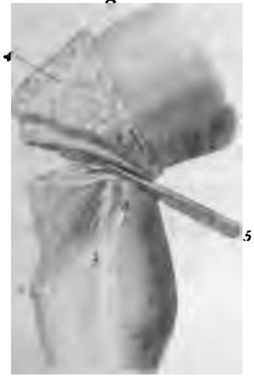
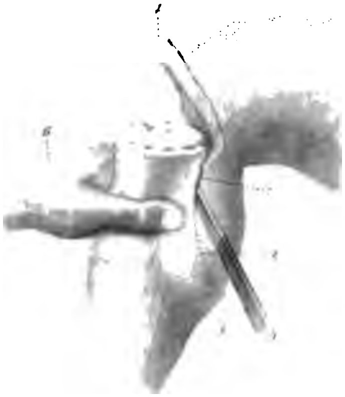


Fig. 7



§ 3.—Statistics of Amputation at the Hip-Joint.

In a valuable paper by Stephen Smith, of New York,* "On Amputation at the Hip-Joint," we find some carefully elaborated statistics of the results of this operation.

From this it appears that amputation at the hip-joint has been performed in continental practice 35 times, of which 14 were successful and 21 fatal, being a mortality of 60 per cent. Four died in 24 hours, of which 2 were in military surgery and amputations "of complaisance."

In the United States this amputation has been performed 11 times, of which 8 were successful and 3 fatal, being a mortality of 27$\frac{3}{11}$ per cent. In 3 cases the operation was performed by the lateral flaps, 1 successful and 2 fatal; 3 with the antero-posterior flaps, all successful; 1 by the circular method, which was fatal; and in 4 others the method is not stated. In 3 cases anæsthetics were employed, and in all the operation was successful.

Summary.—The entire number of these cases of amputation is stated by Smith to be as follows:—

	Cases.	Died.	Cured.	Mortality.
Continental practice	53	33	20	62$\frac{14}{53}$
British practice	34	20	14	56
American practice	11	3	8	27$\frac{3}{11}$

I am unable to say positively whether all the cases alluded to in the above statistics include those collected by myself, and mentioned at the commencement of this chapter; but it is evident that I make 13 cases, of which 9 were cured and 4 died, while the above table shows in the United States 11 cases and 8 cures. If these are added to those I have collected, it would make 24 operations in the United States, of which 17 were cured and 7 died.

SECTION II.

AMPUTATION OF THE THIGH.

Amputation in the Continuity of the Thigh, or the division of the femur through its shaft, may be required in any portion of its length, the selection of the point for the amputation being generally regulated by circumstances. As much of the thigh as is possible should, however, always be preserved in order to facilitate the subsequent application either of an artificial limb or of the wooden peg. In the formation of the portion of the soft parts that is to form the stump, any of the methods of amputating may be selected, though the circular operation of Petit, with reversion of the skin and a circular division of the muscles, or the plan of Alanson, as hereafter described, will generally form better stumps than either the flap or oval method.

As usually performed, this operation corresponds with those described in connection with amputation of the humerus, the same kind of retractor—two tails—and the same dressings being, in most instances, requisite. In a large and muscular limb, the following operation may be made to form quite as good a stump, and be more quickly performed than the ordinary circular method, as it does away with the necessity of dissecting up the "cuff" of the skin.

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* New York Journ. Med., vol. ix. p. 184. 1852.

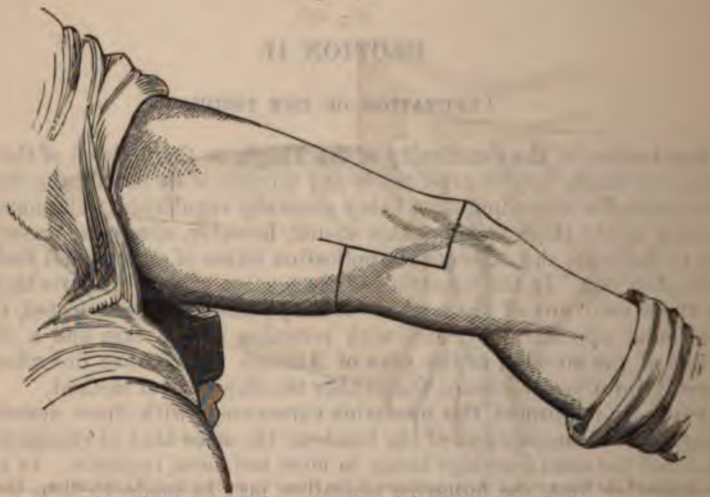
§ 1.—Circular Operation of Alanson.

Operation.—The limb to be amputated being carried off from its fellow, and the artery compressed, the surgeon should place himself between the patient's limbs or upon the outer side of them, as he finds it most convenient, and then, while the skin is strongly retracted by the hands of an assistant, divide it circularly, by holding the knife as directed for amputation of the arm. After making this incision, touch with the point of the knife the loose attachments of the skin to the fascia, so as to favor its retraction by the assistant, Plate LXXVII. Fig. 1, and again applying the knife with its edge directed obliquely upward, at an angle of 13° to the bone, divide the outer layer of the muscles; have them also retracted by the hand, and, with the blade of the knife still inclined upward, cut through the deep layer of the muscles dividing the few fibres adherent to the bone, a little higher up, by carrying the point of the knife around them. Then apply the retractor, and saw the bone close to the muscles, when a conical hollow stump will be formed with the bone in the apex of the cone. Ligate the femoral and other arteries; see that the ischiatic nerve does not protrude; cut it short, if it does; bring the ligatures out of the lower side of the wound, and unite it longitudinally, or parallel with the axis of the limb, by two sutures and adhesive strips, applying subsequently the water-dressing.

§ 2.—Flap Operation.

The **Flap Operation** may be performed either by making an anterior or posterior flap, or by an external and internal one, Plate LXXVII. Fig. 2.

Fig. 455.

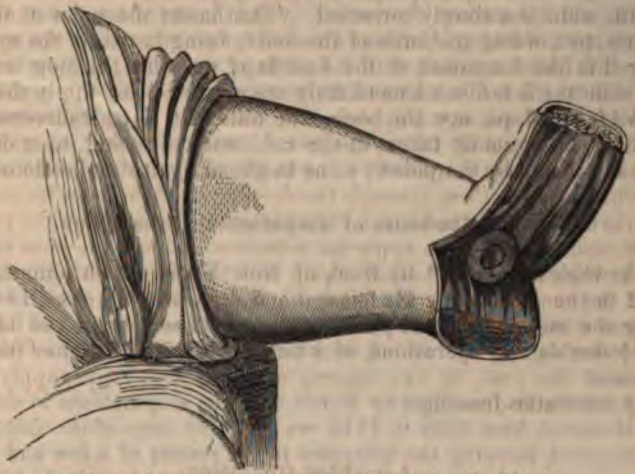


Line of incisions for Teale's amputation of the Thigh. (After Teale.)

The first is preferable, as it prevents the tendency of the end of the bone to project at the anterior end of the angle formed by the union of the internal and external flaps, which is very apt to ensue unless care is taken to support the muscles and prevent their gravitating toward the back of the limb. The operation by the external and internal flaps is shown in Plate LXXVII., and the antero-posterior flaps may be formed as follows:—

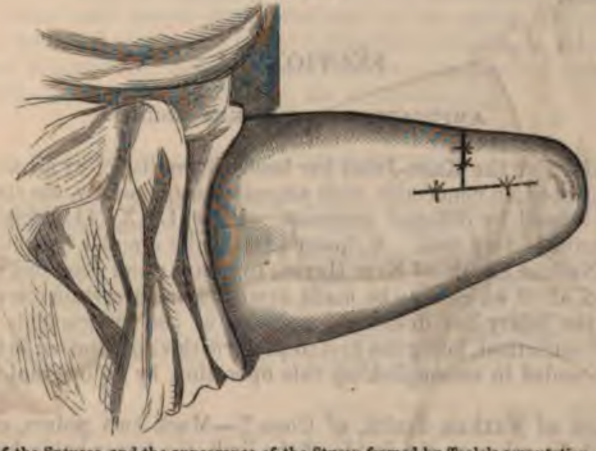
Teale's Operation.*—Assuming the circumference of the thigh to be sixteen inches, trace two longitudinal lines on each side of the limb, eight inches long, making the inner line to fall as near as possible to the femoral vessels, without including them in the long flap, or anterior. Join these two lines by a transverse line of eight inches, Fig. 455. Then mark a short flap of two inches from the upper end of the long flap, cut through the integuments only in the lateral lines of the long flap with the front of the catlin, and make the transverse cut directly to the bone, shaving off all the structures from below upward close to the bone. Then, by one sweep of the knife down to the bone, form the short flap, shaving this flap from the bone to the point where the latter is to be sawn through, Fig. 456. Take up the arteries, and adjust the flaps by placing the sutures, as shown in Fig. 457. The stump should be

Fig. 456.



The Flaps as formed in the Thigh by Teale's method. (After Teale.)

Fig. 457.



The Points of the Sutures, and the appearance of the Stump formed by Teale's amputation. (After Teale.)

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* Op. citat.

laid on a sheet of gutta-percha, a cradle placed over, and the stump not raised from the sheet for five days, so as to insure union and prevent an accumulation of pus.

Operation of Vermale.—Seize the muscles on the front of the thigh with the left hand, elevate them from the bone, and, transfixing them with the long catlin, cut a flap of proper length by passing the catlin from within outward, and from above downward. Then insert the point of the knife at the same spot, working it around the bone; bring it out at the spot where it appeared in the formation of the first flap; and then, cutting the posterior flap, divide the few fibres immediately around the bone, apply the retractor, draw back the flaps, saw the bone, and unite the flaps transversely. Care should be subsequently taken, in the cold water-dressing, to make pressure on the lower flap by the pillow, so as to guard against collections of pus.

§ 3.—Statistics of Amputation of the Thigh.

In the tables reported* by Buel, of New York, of the amputations performed in the New York Hospital, we find that in 34 cases 10 were fatal, making the mortality 29·16 per cent.; 15 of those amputated at the thigh were by double flap operations, of which 2 were fatal, or one-fifth of all the fatal cases.

In the statistics furnished by Norris,† of the amputations in the Pennsylvania Hospital, from 1838 to 1840, we find four cases of the thigh, of which all were cured, showing the difference in the results of a few and of a series of operations, and indicating the little value that can be attached to statistics in these cases. Except in a very few cases, the propriety of an amputation will be decided by the anxiety of the patient to prolong life, few being found willing to die if the surgeon will admit there is a solitary chance of success by performing the operation, and unfortunately the science of surgery is not yet so firmly based as to render the result obtained from any calculation certainly correct.

SECTION III.

AMPUTATION AT THE KNEE-JOINT.

Amputation at the Knee-Joint has been accomplished by all the methods before mentioned, in connection with amputations generally, the stump being differently formed by different surgeons. Plate LXXVII. exhibits several of these methods very well. Velpeau advises the circular operation; Hoin one flap; Nathan Smith, of New Haven, two flaps; and Baudens, of France, an oval flap, all of which may be made available under certain circumstances, as where the injury has destroyed portions of the integuments. Nathan Smith, of Connecticut, being the first to perform this amputation in the United States, succeeded in accomplishing this operation by an original and useful method.

Operation of Nathan Smith, of Conn.‡—Mark two points, one on the outside and the other on the inside of the limb, the latter being half an inch below the head of the tibia, and the other opposite to it. Then draw a semicircular line from one point to the other over the anterior part of the leg, in such a direction that its lower part shall touch the lower part of the tubercle of the tibia, and then mark another circle on the posterior part of the leg exactly corresponding to the former, so as to form two flaps, the anterior of which will be formed by the patella and its ligament, and the posterior by the head of the gastrocnemius, tendons of the flexor muscles, and the popliteal blood-vessels and nerves. In operating, the anterior flap should be first raised with the patella by cutting through its ligament, which will expose the front of the joint and render the division of the lateral ligaments easy; after which two or three strokes of the knife will complete the section of the crucial ligaments and the posterior flap. This patient recovered with a good limb, the stump being formed at its lower part by the patella, which became adherent to the femur.

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* Am. Journ. Med. Sciences, vol. xvi. N. S. p. 33.

† Ibid., vol. xxvi. p. 35, May, 1840.

‡ New York Journ. Med., vol. ix. p. 313, on Amputation of Knee-Joint, by Willard Parker, M.D., N. Y., from Am. Med. Review, vol. ii. p. 370.

Operation of Parker, of New York.*—The patient being placed on a table of suitable height, anæsthesia was induced by a mixture of chloroform and ether; pressure made upon the femoral artery in the groin; the integuments of the thigh forcibly drawn upward from the knee, and the leg held in a flexed position. Then, an incision being made upon the front of the leg, about one inch below the insertion of the ligament of the patella, an anterior flap was formed by dissecting up the integuments as far as the upper portion of the joint, when the patella was removed from its attachments, and the knife passed through the joint over the head of the tibia, the flap being completed by cutting it from the posterior part of the calf. The integuments being then brought together, were united by sutures, and the stump dressed.

Operation of Baudens, of Paris.†—The patient being laid on the table, as in the amputation of the leg, draw with a pen a line, which, starting from the spine of the tibia, three fingers' breadth below its tubercle, shall ascend obliquely backward, and from below upward, toward the popliteal space, *to terminate* two fingers' breadth *below a line corresponding to the insertion of the ligament of the patella.* An assistant now retracting the skin as much as possible, cut with a large scalpel, or small catlin, through *the skin* in the line just described, and reflect the integuments to the level of the knee-joint; then, dividing the ligament of the patella, flex the leg, open the joint, cut the crucial and lateral ligaments, and by one sweep cut through the structures behind the joint. After arresting the hemorrhage, force down the patella and integuments, and unite the latter on the back of the thigh by a few stitches, dressing the stump with the water-dressing.

§ 1.—Statistics of Amputation at the Knee-Joint.

In the paper by Parker, of New York,‡ it is stated that amputation in this joint, as performed in the United States, bears a flattering comparison with that of any other country, 12 operations having been performed, of which 7 were completely successful, being a mortality of one-fourth, or 25 per cent.; 2 required reamputation, 1 for gangrene and 1 for a chronic disease. In foreign practice, there were 28 cases, 12 deaths, and 16 cured, or a mortality of $42\frac{6}{7}$ per cent. As tabulated by Parker, the results are as follows:—

	Cases.	Cured.	Died.	Mortality.
American practice	12	9	3	25 per cent.
Foreign "	28	16	12	$42\frac{6}{7}$ "
Malgaigne's collection	9	2	7	$77\frac{7}{9}$ "
Jager's "	37	22	15	40 "
Total	86	49	37	43

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* New York Journ. Med., vol. ix. N. S. p. 308.

† Malgaigne, Philada. edition.

‡ New York Journ. Med., vol. ix. N. S. p. 308.

Parker therefore concludes:—

1st. That amputation at the knee-joint is a justifiable operation as respects the nature of the structures engaged.

2d. That it is a justifiable operation as respects the point of election.

3d. That the stump is well calculated to sustain pressure, and also well adapted to the adjustment of an artificial limb.

Remarks.—The question of "the propriety of amputating through the joints," is one which has engaged considerable attention at different periods, and was for many years regarded as settled by the general opinion of surgeons that it was more dangerous to amputate through the joints than through the shaft of a bone, in consequence of the presence of the synovial membrane, etc. giving rise to severe constitutional disturbance. In the first edition of my Operative Surgery, I coincided in these views, and discountenanced the operation; but subsequent observation, and an investigation of the more recent accounts of the effects of inflammation on articular cartilages, have induced me to believe that I was in error, and that the opinion generally advanced on the subject is, perhaps, like my own, somewhat the result of the general tendency of many to "follow the leader," or travel in the beaten path rather than investigate for themselves. A close examination of the evidence for and against these amputations in joints will show that among the ancients Celsus condemned, but Galen and Heliodorus advocated them; while Sabatier, Nathan Smith, of Connecticut, Brasdor, Larrey, Velpeau, Blandin, Textor, Fergusson, and Malgaigne, among the moderns, advocate them, the latter having been ably seconded by Baudens, of France, Parker, of New York, and Pancoast, Agnew, and others, of Philadelphia. I am therefore induced to regard this question as unsettled, and to incline to the opinion that experience will yet demonstrate its propriety. The idea which appears to have been so very prevalent as to the effects of inflammation of the articular cartilages, synovial membrane, etc., is certainly not sustained by facts, and seems to have been rather a theoretical than a practical objection. In the case reported by Pancoast, of Philadelphia,* cicatrization was completed at the end of the fourth week, and was unattended by a single bad symptom. As one of the condyles also became exposed from the unavoidable shortness of the flaps, the changes in the articulation could be readily noted, and it was found that "the articular cartilages neither became reddened nor painful, nor exhibited any coating of synovial membrane, or other appearance of organization; but by the end of a week became soft and pulpy on its free surface, like a recent joint while macerating for the anatomist. This pulpy layer was, however, insensibly removed with the discharges, and the articular face of the condyles being completely bared in the third week, granulated and adhered to the cutaneous granulations. No appearance of synovial inflammation of the bursa above the joint was manifested during the treatment, and the patella continued movable on the upper anterior face of the condyles." As articular cartilages, when inflamed, pass through a process similar to the degeneration of inflamed bones—that is, either soften and liquefy or tend to fatty degeneration—and as they possess few or no blood-vessels, there is reason to think that, after amputation through the knee-joint, this process must be the usual one, and that the skin and soft structures will therefore readily adhere to the condyles of the femur, thus insuring the action of the flexors and extensors of the leg, while, by transferring their action to the end of the femur, they facilitate very materially the subsequent progression of the patient. In most instances, where nature throws off a part, in the manner formerly designated as ulceration, but now more correctly spoken of as interstitial absorption and liquefaction, there is sufficient lymph effused to serve as a limit to the action, and there is, therefore, no good reason to think that the removal of the articular cartilages from the condyles of the femur will predispose the latter to carious inflammation. In Pancoast's case the cure was prompt, being within thirty days, so that the liquefying removal of the cartilages does not necessarily lead to sinuses, fistula, and the other tedious symptoms formerly charged as an objection to articular amputations. But, admitting that the healing of the stump should be tedious, will not the patient be the gainer in the end by the increased ability with which he can move the limb, to say nothing of the increased ease and gracefulness of his progression? When the patella is left, and brought down so as to fill up the trochlea and equalize the condyles, it gives a breadth and roundness to the stump, which adapts it remarkably well for a point of support, while the skin over it is likewise well calculated to sustain pressure without the development of inflammation. It also secures to the patient the usual flexion and extension of the thigh, and does away with the compass-like movement caused by the rotating muscles, which is so apparent in those who walk on the common peg or wooden leg. I therefore commend this amputation to special consideration in all cases requiring amputation of the leg above the tubercle of the tibia, when the femur is not diseased.

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* Op. Surg., p. 170.

SECTION IV.

AMPUTATION OF THE LEG.

Amputation of the Leg is to be accomplished by any of the preceding methods, care being taken to leave as long a stump as possible, if the patient is to wear an artificial limb, but to saw off the bone at about three fingers' breadth below the tubercle of the tibia, if he is to wear "the peg," as a long stump, under these circumstances, would be a constant source of inconvenience to the patient, from its projecting behind the body, when the peg was applied.

§ 1.—Circular Amputation of the Leg.

The circular operation for amputation of the leg may be accomplished as follows:—

Ordinary Operation.—The patient being placed on a table, or bedstead, with the injured limb projecting over the side of the bed at least as far as the knee, let one assistant apply the tourniquet on the femoral artery, as before directed, or compress it with the fingers while the anæsthetic is being administered. Let a second assistant now support the lower portion of the limb, and a third be ready to control the movements of the sound limb, or let the foot of the sound limb be attached, by a towel or bandage, to the bed-post or table-leg. Then, standing so that the left hand will grasp the upper portion of the leg, take the large amputating-knife firmly in the right hand, kneel or stoop down, and, passing the hand so far around the limb that the point of the knife will be directed to the right shoulder, apply the heel of the knife to the skin, and, by a circular sweep, cut it around the leg; rising up and strongly flexing and pronating the hand, in order to terminate the incision at the spot where it commenced. Then, laying down the knife, seize the skin and dissect it up by long sweeps of a large scalpel, until a portion can be reverted all round the limb, to about the extent of one-sixth of its diamapplied so as to divide the fibula and tibia nearly at the same

After Bern

Fig. 3. Appearance of the Wound left in this Operation. 1. T up the integuments. 2, 2, 2. The position of the blood-vessels i The section of the tibia. 4. The section of the fibula.

After Bern

Fig. 4. Different Positions of the Catlin in dividing the Mus Bones and in the Interosseous Space. 1. The tibia. 2. The position of the catlin in clearing the superior and inner side of th same for the parts around the tibia. *After Bern*

Fig. 5. The same Operation, as performed on the Under S 1, 2. Tibia and fibula. 3. The first position of the knife.

After Bern

Fig. 6. The Appearance of the Wound after Lenoir's Amputat Leg. 1, 2. The lateral angles of the flap. 3. The tibia. 4. T

After Bern

Fig. 7. The changes made by Nature in the Femur after an The shaft. 2. The cut extremity as closed and rounded by nat

After Bour

Fig. 8. Changes in the Stump, as seen several months after 1. Upper part of the stump. 2. Integuments on its end. 3. T across. 4. The artery. 5, 5. The veins. 6. The nerve. 7. A of the artery. *After Bour*

Fig. 9. Appearance of the Tibia after Amputation. 1. Its b

Plate

Fig 1.

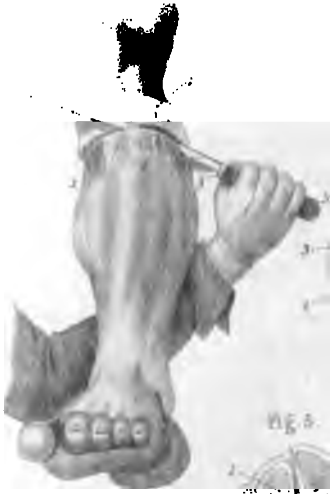


Fig 3

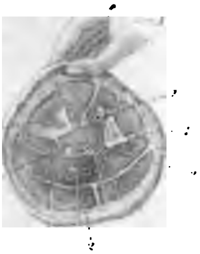


Fig. 2

Fig. 5.

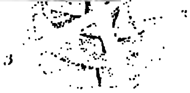
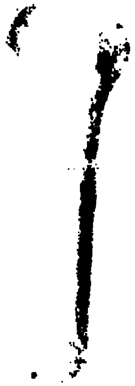


Fig. 4.



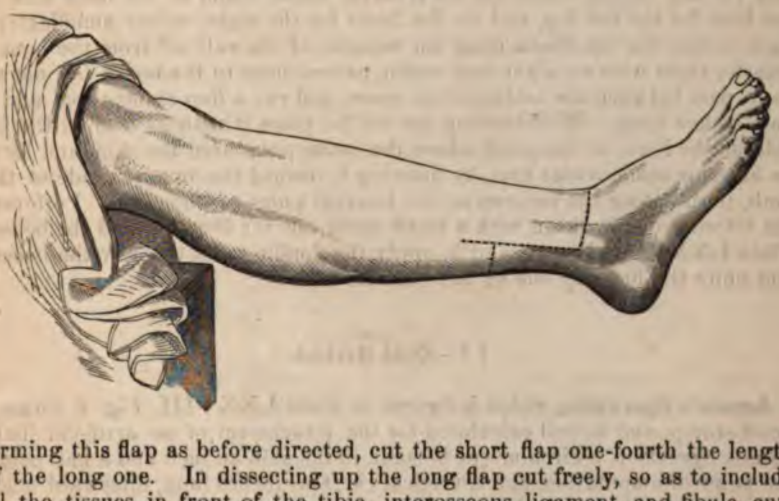
eter. Then again taking the large knife, apply it as before to the muscles, within a half inch of the reverted edge of the skin, and by one sweep, with a slight sawing motion, cut all the muscles to the bone; perforate the interosseous space with the catlin, or the knife, if not too large; pass in a three-tailed retractor, and saw the bones close to the retractor, taking care to divide the fibula before the tibia is entirely sawed through. Then, after tying the anterior and posterior tibial with the peroneal arteries, and any muscular branches that may bleed, bring the ligatures out at one corner, and close the skin with three sutures, so that the cicatrix may be vertical; after which apply the water-dressing.

Remarks.—In this amputation, attention should be given to the length of the stump, before commencing the operation—a long stump being requisite for the attachment of an artificial leg, while if the stump is to rest on the "peg," the bone should be divided within three fingers' breadth of the tubercle of the tibia, for the reasons before assigned. The remarks in relation to the advantages of a stump formed by the circular operation over one formed by the flap, as before made, are also especially applicable to amputation of the leg.

§ 2.—Flap Operation on the Leg.

Teale's Operation.*—Supposing the circumference of the leg low down to be nine inches, make a long anterior flap of four and a half inches, the outer side being formed along the posterior edge of the fibula, and the inner line four and a half inches from this, as shown in Fig. 458. Then, after forming this flap as before directed, cut the short flap one-fourth the length of the long one. In dissecting up the long flap cut freely, so as to include all the tissues in front of the tibia, interosseous ligament, and fibula, cutting close to the periosteum and interosseous ligament. On reverting this flap, make the transverse cut on the posterior surface of the leg so as to join the two sides of the anterior flap, and dissect back to the extent of two

Fig. 458.



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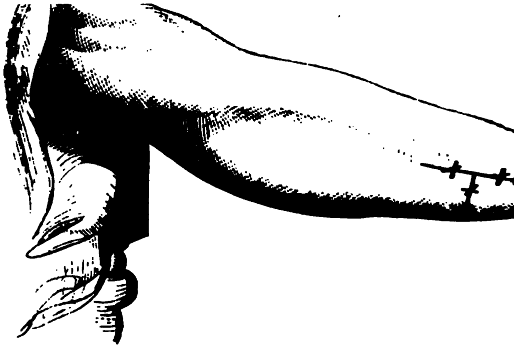
* Op. citat.



Remarks.—Teale's operation has never seemed to me as
the leg as to the thigh, arm, and forearm.

Flap Operation of Verduin.—The artery being compress
and the leg carried somewhat off from its fellow, stand on
the limb for the left leg, and on the outer for the right, unl
then, feeling for the fibula, draw the muscles of the calf off
transfix them with an eight-inch catlin, passed close to the b
as to pass between the interosseous space, and cut a flap ab
half inches long. Withdrawing the catlin, place it with it
side of the limb, at the point where the catlin punctured th
an anterior semicircular flap, by drawing it toward the opp
limb, terminating the incision at the internal point of punct
the interosseous ligament with a small catlin, cut the fibres a
Plate LXXVIII. Figs. 4 and 5, apply the double retractor,
and unite the flaps by one or two sutures.

§ 8.—Oval Method.

SECTION V.

AMPUTATION AT THE ANKLE-JOINT.

The importance of preserving as much as possible of the leg, in order that the patient may not be compelled to obtain the support of an artificial one, has induced many surgeons, and especially Syme, of England, to revive the amputation formerly practiced through the **tibio-tarsal articulation** when the disorder or injury was limited to the foot. The amputation may be accomplished by either of the following methods:—

Operation of Syme, of England.—Make a semilunar incision of the skin, with its convexity toward the toes, by carrying a short catlin around the front of the ankle from one malleolus to the other, and dissect up the flap. Then placing the foot at a right angle to the leg, form the posterior flap by drawing the knife through the skin from the centre of one malleolus to the other directly across the sole of the foot, so that the points of the anterior and posterior incisions may join and form an angle of 45°. On dividing the front of the capsular ligament of the ankle, free the astragalus and dissect the posterior flap off from the os calcis by working close to the bone, so as to preserve as much as possible of the posterior tibial artery for the nourishment of the posterior flap. Then, either sawing off the projecting malleoli or cutting them with the bone-nippers, arrest the hemorrhage and close the flaps with sutures. Apply the warm water-dressing until the vitality of the flaps is certain.

Operation of Velpeau.—Make two semilunar incisions convex forward through the skin, one over the instep and the other above the heel, twelve or fifteen lines in front of and behind the joint, and unite them so as to form another semilunar incision on each side about an inch below the ends of the malleoli. On dissecting back the skin, divide as near the joint as possible the extensor tendons of the toes, the peronei tendons, the tibialis anticus, the flexors of the foot, the tendo-Achillis, and the external and internal lateral with the capsular ligaments. Disarticulate the bones, and bring the antero-posterior flaps together, so that the lateral flaps may cover the ends of the malleoli—these ends, according to Brasdor, being rounded off by nature, and not therefore requiring to be excised. If the astragalus can be left, as advised by Ligneroles, it will improve the surface for pressure.

Operation of Pirogoff.—Pirogoff has recently called professional attention to a modification of the amputation at the tibio-tarsal articulation, which is performed as follows:—

Operation.—Make a perpendicular incision by a small catlin through all the soft parts, commencing two lines in front of the external and running round the sole of the foot to a similar point at the internal malleolus, or the reverse. Then connect the end of this incision by a second cut in front of the tibio-tarsal articulation, making it slightly convex anteriorly, and, opening the joint, divide the lateral ligaments, dislodge the astragalus, and with a narrow saw cut obliquely and from above downward, through the os calcis in a line directly posterior to the head of the astragalus. The flaps being now dissected from the tibia and fibula, saw off the malleoli, and bring the posterior flap—heel and tendo-Achillis—forward so as to coaptate the cut surface of the calcis with the cut surface of the tibia, and unite the flaps by sutures.

Remarks.—Of all the amputations at the ankle-joint Pirogoff's is the best, the posterior flap being less likely to slough than in Syme's operation; but as it gives the patient a comparatively small point of support, it will generally be better to amputate the leg above the ankle. Pirrie and Watson, of England, advise sawing through the os calcis from below upward; but in either method it is important to make the section of the bone at such an angle as will cause it to adapt itself to the flat end of the tibia. It will also prove advantageous to divide subsequently the tendo-Achillis, as in the operation for Pes Equinus. Various other modifications of Pirogoff's method have been made, but there is nothing in them specially worthy of notice. The advantages of the amputation at the ankle-joint, like those at the knee-joint, have been much discussed, and many arguments advanced for and against it. Of four cases that have come under my notice, three did well, the patients being able to walk with a boot similar to that shown in Plate LXXVIII. Fig. 10. There is, however, as far as I have seen, always trouble in preventing the accumulation of pus beneath the posterior flap, in Syme's operation, and also a tendency to sloughing in the edges of the flaps, which sometimes goes to a greater extent. Pirogoff's operation, though requiring great care in the subsequent dressing to prevent suppuration in the sheaths of tendons, etc., is a better method, if it is necessary to amputate at the joint. As the circular amputation immediately above the joint furnishes a good stump for an artificial leg, the foot of which is less unnatural in its appearance than the inflexible cork, which must be employed to fill up the shoe that is required after amputation at the ankle-joint, and as the point of the heel does not afford a good basis of support, the patient walking like a boy on stilts, I prefer amputation of the leg low down, and the adaptation of a good artificial limb.

Börckel, of Strasburg, in a pamphlet entitled "Les Avantages et les Inconvenients de l'Amputation de la Jambe au lieu d'élection comparée aux Amputation sus Malléolaire et partiel du Pied," states that statistics prove that the supra-malleolar amputation of the leg is more favorable in its results than that three or four inches below the knee; the mortality in the first case being, according to Fenwick, 1 in 4½; in the second, 1 in 2½. This he attributes to the wound being smaller and farther from the body, and to the rare occurrence of pyemia and phlebitis. There is also a better support for artificial contrivances, if these are judiciously made.

In tibio-tarsal exarticulations, the average mortality is 1 in 7·2. He prefers the plantar flap of Syme to the dorsal of Bouden.

The patients operated on by exarticulation below the astragalus and by Pirogoff's operation are not sufficiently numerous for a definite conclusion as to their value. Börckel reports seven favorable cases of the former and nine of the latter, of which one was fatal.

SECTION VI.

AMPUTATION OF THE FOOT AT THE TARSUS.

In order to save as much of the foot as might suffice to support the patient, amputation through the tarsal and metatarsal joints has been suggested, and often practiced. Either of these amputations requires an accurate knowledge of the relations of the articulating surfaces of the bones, and should not be attempted without a recent examination of the part by those not perfectly familiar with it. In the hands of an anatomist, they constitute two of the most valuable and scientific methods of amputating resorted to in connection with the lower extremity, preserving a valuable portion of the foot, and one which adds greatly to steady progression. To facilitate reference, the parts have been fully shown in Plates LXXIX. and LXXX., and their anatomical relations may, therefore, be omitted here. This amputation may be performed at one of two points, either between the articulation of the cuboid and scaphoid with the os calcis and astragalus, or at the metatarso-tarsal articulation. The first is usually described as Chopart's, the second as Lisfranc's or Hey's operation.

Chopart's Operation.—After recognizing the position of the joint, grasp the foot with the left hand, so that its *palm* may present to the sole of the patient, placing the thumb upon the external extremity of the joint, and the forefinger upon the internal. The thumb in the right foot would rest against the cuboid, and the forefinger on the scaphoid bones, while in the left foot it would be the reverse. As this position indicates the joint, the thumb and finger should be held there until the skin is divided.

Then, being sure of the joint, carry a small catlin across the top of the foot, from the thumb to the point of the forefinger, making a semicircular incision slightly convex forward, which shall descend about half an inch in front of the articulation, and, directing the assistant to draw up the skin, divide the extensor tendons and the dorsal ligaments, rendering the latter tense by pressing the toes downward, Plate LXXIX. Fig. 2. Then divide the lateral ligaments, and pass the knife through the articulation at such an angle of inclination as will enable it to adapt itself to the surface of the bones, after which the flap should be formed by shaving it off from the sole of the foot, Plate LXXIX. Fig. 3.

Lisfranc's or **Hey's Operation.**—Amputation at the metatarso-tarsal articulation was suggested by Hey, of England, who accomplished it by sawing off the ends of the metatarsal bones; and the amputation is, therefore, now often spoken of as Hey's operation. As the section of the ends of these metatarsal bones was frequently followed by caries and subsequent abscesses, it has generally been deemed best to disarticulate them, as proposed by Lisfranc; and as this is an important modification, the disarticulation should be designated as the operation of Lisfranc, and so described. Various rules have been given to find the joint, but I have always found the following one sufficient, *i.e.* to "draw a transverse line across the foot, from the superior extremity of the fifth metatarsal bone, and it will fall upon the inside of the foot, two-thirds of an inch *behind* (or above) the articulation."

Operation.—After finding the position of the joint, seize the foot, so that the thumb, if in the right foot, shall rest on the tuberosity of the fifth metatarsal bone, and the index or second finger half an inch in advance of the internal side of the joint at the cuneiforme internum, and retain them in this position until the first incision is made, Plate LXXIX. Fig. 9. Then, with a strong, short catlin, make a semicircular flap incision on the dorsum of the foot, cutting from the thumb toward the finger, half an inch in front of the articulation, and, by a few touches of the point of the knife upon the adhesions, facilitate its retraction by an assistant. Then, placing the heel of the knife close to the end of the fifth metatarsal bone, divide the lateral and dorsal ligaments, and open the joint as far as the third metatarsal bone; and, on reaching this point, carry the knife half an inch backward, or nearer to the ankle, cut the dorsal ligaments, and expose the second metatarsal bone. Now, acting only with the point of the knife, and holding it perpendicularly, Plate LXXIX. Fig. 10, insert its point between the bones on a line with either the first or second metatarsal spaces, or close to the side of the head of the second metatarsal bone, and rocking it backward and forward, cause it to graze the lateral surface of the first metatarsal bone; and then, by a sawing motion, open the joint between it and the internal cuneiform. Do the same thing on the outer side of the head of the bone, and, dividing the interosseous ligament, press upon the metatarsus, and complete the division

PLATE LXXIX.

AMPUTATIONS OF THE FOOT.

Fig. 1. A view of the Bones composing the Tarsal Articulation, as involved in Chopart's Operation. 1. The astragalus. 2. The os calcis. 3. The cuboid. 4. The scaphoid. 5. Internal point of the joint, or tuberosity of the scaphoid bone. 6. External point of the articulation. 7. Head of the fifth metatarsal bone. 8. The fibula. 9. The tibia. 10, 10. Two pins to show the direction of the articulating surfaces or line in which the knife must be passed.

After Bernard and Huette.

Fig. 2. Position of the Hand of the Surgeon, and the Line of Incision in Chopart's Operation. 1, 2, 3. The line of incision. *After Bernard and Huette.*

Fig. 3. Continuation of the same Operation. The joint being opened, the knife is about to form a flap from the sole of the foot. 1. The anterior tibial artery. 2. The knife. *After Bernard and Huette.*

Fig. 4. Sedillot's Operation. 1, 2, 3. The line of incision.

After Bernard and Huette.

Fig. 5. A side view of the Outer Side of the Bones of the Tarsus, showing the Oblique Direction of the Articulating Surfaces over which the Knife is to pass. 1. The os calcis. 2. The cuboid. 3. A pin in the joint. 4. The joint between the astragalus and scaphoid, with a pin in it to show its inclination.

After Bernard and Huette.

Fig. 6. Side view of the Inner Side of the same Bones. 1. The astragalus. 2. The scaphoid. 3, 4. Pins in the joints. *After Bernard and Huette.*

Fig. 7. Dorsal view of the Bones of the entire Foot. 1. The tibia. 2. The fibula. 3. Astragalus. 4. The os calcis. 5. The scaphoid. 6. The cuboid. 7. Internal cuneiform. 10, 11, 12, 13, 14. The five bones of the metatarsus. 15. The phalanges of the toes. *After Bernard and Huette.*

Fig. 8. Dorsal Articulating Ligaments of the Foot. 1, 1. Anterior tibio-tarsal ligament. 2. The anterior portion of the external lateral ligament. 3. The internal calcaneo-scaphoid ligament. 4. The external calcaneo-scaphoid. 5. The astragalo-scaphoid. 6. The calcaneo-cuboid. 7. The scaphoideo-cuneiform. 8. The cuboideo-metatarsal. 9. The cuneiforme metatarsal ligaments.

After Bernard and Huette.

Fig. 9. Lisfranc's Operation on the Right Foot. 1, 2, 3. The line of the incision in the skin. 4. The thumb of the surgeon on the extremity of the fifth metatarsal bone. 5. His forefinger on the metatarsal bone of the first toe.

After Bernard and Huette.

Fig. 10. Manner of opening the Articulation of the Second Metatarsal with the Middle Cuneiform Bone. 1, 2, 3. The arch of the circle formed by the knife in its different positions. 4. The second metatarsal bone. 5. The first metatarsal bone. 6. The end of the fifth metatarsal bone.

After Bernard and Huette.

[illegible]

Fig. 1

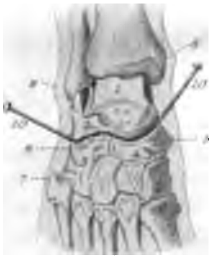
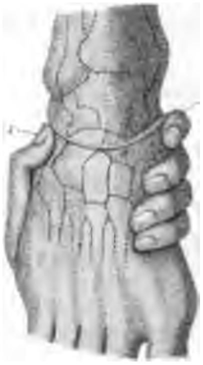


Fig. 2



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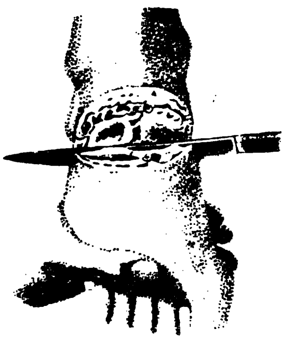

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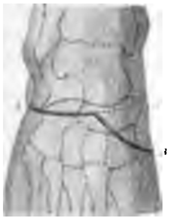

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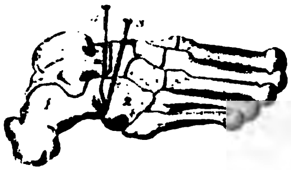


Fig.

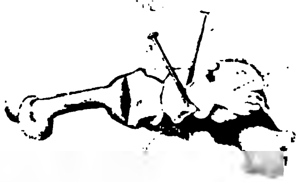


Fig. 10

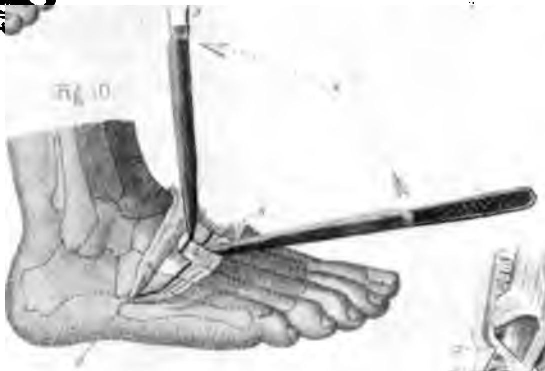


Fig.

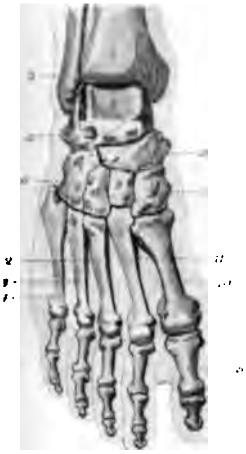


Fig. 9

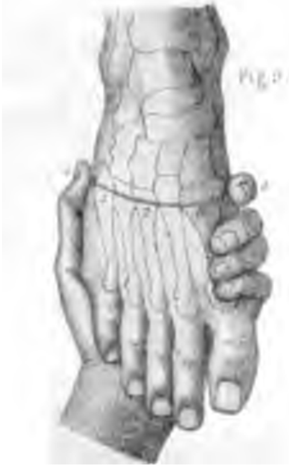
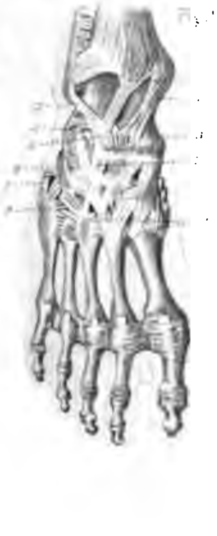


Fig.



of the remaining ligaments; when, passing the knife flatwise beneath the foot, form a flap out of the integuments on the sole of the foot, by shaving them off close to the metatarsal bones, making the flap longest on its inner edge so as to meet the increased thickness of the tarsus on this side.

Remarks.—The circumstances under which either Lisfranc's or Chopart's operation would be performed being very different, it is hardly desirable to attempt any comparative estimate of their value. Lisfranc's operation is certainly preferable to Chopart's when it is admissible, in consequence of its affording a greater length of foot, and thus adding to the patient's stability, and, with a good shoe, constructed as shown in Plate LXXVIII. Fig. 11, a very useful limb can be obtained.

Börckel states* that in Chopart's operation the average mortality is one in nine.

The amputation at the metatarsal bones and Lisfranc's tarso-metatarsal exarticulations produce better results than all other partial amputations of the foot.

SECTION VII.

AMPUTATION OF THE TOES.

Amputation of the Toes—Plate LXXX.—may usually be accomplished by the same methods as the fingers, with the exception of the articulation of the metatarsal bone of the first toe. In this amputation, whether performed by the flap, oval, or circular method, it has been recommended to saw off the round head of the first metatarsal bone after the phalanx is removed, as it is apt to become a source of irritation from pressure against the boot. But as the hard skin of the under surface of the foot can be made to cover it thoroughly in many instances, I think it is better not to remove it, as this end of the bone is of great service in giving the patient a firm step, and preventing an inclination of the foot inward, it being one abutment of the foot. The other amputations of the toes are sufficiently explained in Plate LXXX. Figs. 5 to 12.

SECTION VIII.

ORGANIC CHANGES RESULTING FROM AMPUTATIONS.

The changes which result from the removal of a portion of the extremities by amputation may be noticed both in the part and in the general health of the patient within a short period after the operation.

Local Changes.—In the stump, the approximation of the superficial to the deeper-seated parts, produced by closing the wound, naturally leads to a general matting together of the skin, fascia, muscles, blood-vessels, and nerves; while the inflammatory changes connected with the process of healing often create bands of condensed areolar tissue, which, when thickened by pressure, become almost cartilaginous in their density. The changes produced in the muscles, it has usually been thought were due to atrophy, and that the difference in the development of a stump, as compared with the muscles of the opposite limb, was the result of a defect of circulation. The observations of Spence,

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* Op. citat.

PLATE LXXX.

AMPUTATION OF THE TOES.

Fig. 1. A view from above of the Dorsal Ligaments as opened by the p of the knife in Lisfranc's Operation, as previously shown in Fig. 10. P LXXIX. 1, 2, 3. The points opened. 4. The hand of the surgeon.

After Bernard and Hu

Fig. 2. Manner of forming the Flap from the Sole of the Foot in Lisfranc's Operation. 1. The anterior tibial artery. 2. The position of the hand of the surgeon on the foot while forming the flap. 3. The position of the knife.

After Bernard and Hu

Fig. 3. The Wound left after Lisfranc's Operation. 1, 2, 3. The shape of t plantar flap. 4. The dorsal flap. *After Bernard and Hu*

Fig. 4. The Wound left in Chopart's Operation. 1, 2, 3. The plantar flap. 4. The blood-vessels. *After Bernard and Hu*

Fig. 5. Amputation of all the Toes through the Metatarsal Bones. 1. T retractor passed into each interosseous space. 2. The saw.

After Bernard and Hu

Fig. 6. The Wound left by the preceding Operation. 1, 2, 3. The plantar fl

After Bernard and Hu

Fig. 7. Disarticulation of all the Toes. 1, 2, 3. The line of the dorsal incis in front of the joints. *After Bernard and Hu*

Fig. 8. Continuation of the same Operation. 1, 2, 3. The dorsal incision. The catlin, after opening the joints, about to form a plantar flap.

After Bernard and Hu

Fig. 9. The Wound left by the preceding Operation

After Bernard and Hu

Fig. 10. Disarticulation of the Third and First Toes. 1, 2, 3, 4. The wou resulting from the oval method on the great toe. 1, 2, 3. The wound formed the two flaps on the third toe. *After Bernard and Hu*

Fig. 11. 1, 2, 3. The line of the incision in disarticulation or resection of first metatarsal bone. *After Bernard and Hu*

Fig. 12. Amputation of the Great Toe. 1, 2, 3, 4. The line of incision in oval operation. *After Bernard and Hu*

Plate 80

Fig. 1.

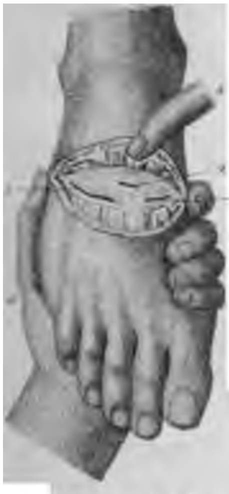


Fig. 4.

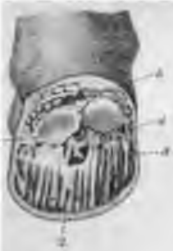


Fig. 2.

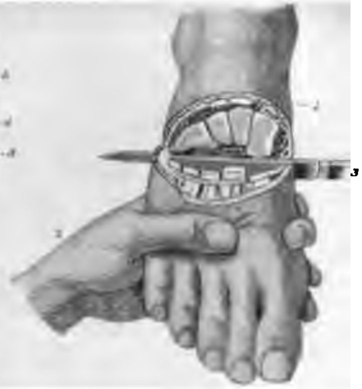


Fig. 3.

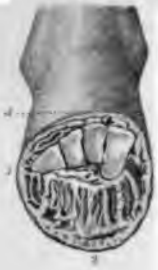


Fig. 6.

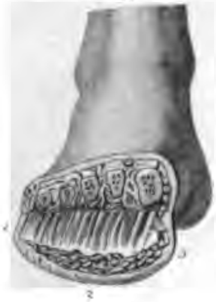


Fig. 5.

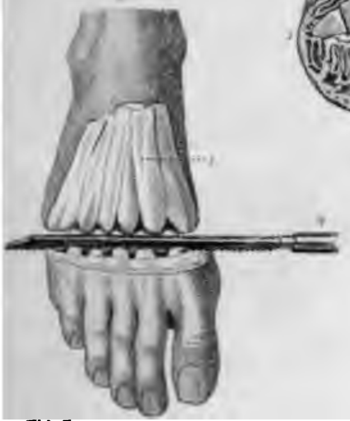


Fig. 9.

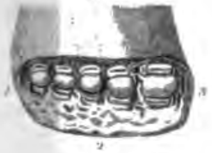


Fig. 7.

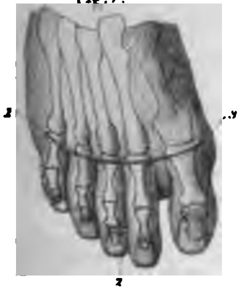


Fig. 8.

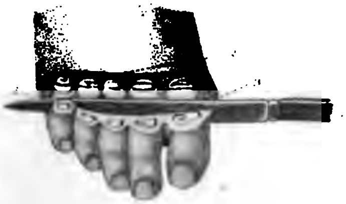


Fig. 10.

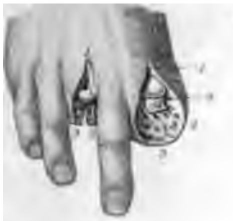


Fig. 11.

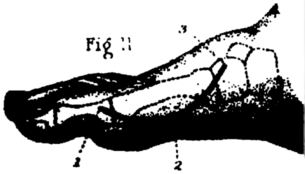
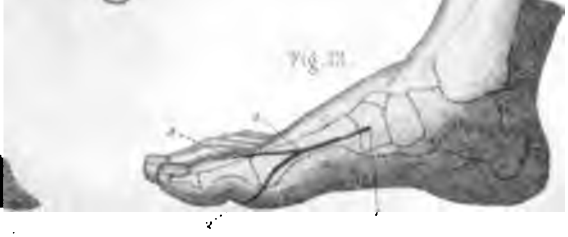


Fig. 12.



of Scotland, as stated* to the Medico-Chirurgical Society of Edinburgh, seem, however, to disprove this. In one stump, formed by a flap operation twelve years previous, dissection showed it to be well formed and covered by muscle. For a few weeks after the healing of a stump, any angles caused by closing the wound remain prominent, and the cicatrices which are formed near them cause a wrinkling of the surrounding integuments; but ultimately the process of absorption and deposition equalizes the surface to a considerable extent, making it much more round and ball-like than before, provided a free amount of integument has been preserved in forming the flap.

The division of the nerves of the part is most frequently followed by a bulbous enlargement at or near the point of section; and if their extremities become inflamed or involved in the line of the cicatrix, the contraction of the latter, by pressing upon them, will occasionally induce severe neuralgia, which, in some instances, has required the stump to be opened, and the nerves to be dissected from the part. Spence† believes that Neuromata are unavoidably formed when nerves are divided, no matter how deeply covered or in what method the amputation is performed. When a nerve is cut across, he has generally found that its neurilemma contracted, and that the nervous fibrillæ projected and ultimately became firmly connected with the lymph effused about the point of section, some fibrillæ being spread out on the surface of the lymph and others imbedded and interwoven in it. These tumors, however, were not productive of pain, unless exposed to pressure against the bone, or so thinly covered as to be exposed to atmospheric influence. The size of these neuromatous tumors was not dependent on their being more or less thickly covered, as some were found, of large size, very deeply seated in the stump.

The cancellated structure of the bone becoming also more or less inflamed after its section, deposit of lymph ensues, granulations are formed at the extremity of the medullary membrane, and, as these become organized, a new deposition of bone follows, which closes the medullary cavity and gives to the extremity a sort of cap, which, becoming rounded and convex, Plate LXXVIII. Figs. 7, 9, is well adapted to sustain pressure without irritating the soft parts when they are forced against it. In some instances there has been an evident growth of the end of the bone, and an apparent increase in its length.

General Changes.—The general changes ensuing upon amputation are often not less marked than the local alterations. In amputations for chronic diseases, and especially in those accompanied by hectic fever, the first night of comfort obtained by the patient is often that immediately ensuing on the operation, while the fever will sometimes disappear promptly. When the portion of the extremity that has been removed is considerable, there is apt to be a marked disturbance of the equilibrium of the system, the process of nutrition going on rapidly, and the patient increasing in size to a remarkable degree, the patient often becoming very fleshy, generally by a deposit of fat beneath the skin. At the same time there is a liability to plethora, which may require treatment on the general antiphlogistic plan.

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* New York Journ. Med., vol. iii p. 408, from London Journ. Med.

† Ibid.

SECTION IX.

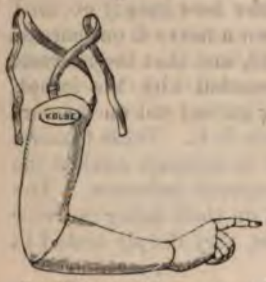
SUBSTITUTES FOR THE NATURAL LIMB.

After the healing of a stump, the surgeon should make it his duty to direct the patient in the attainment of some useful substitute for the portion which has been removed. This must, of course, vary with his social condition.

For the arm of the laboring man, a cap formed of strong leather, to which an iron hook can be attached, and which can be made to strap on to the stump, will answer the purposes of prehension; while patients of larger incomes can now obtain excellent substitutes for the arm and hand from various ingenious mechanics. In numerous instances, artificial arms have been made by means of which the patient was able to grasp his hat and hold a pen or other light articles by a neat mechanism that caused the fingers to approach the palm of the hand. Fig. 460 shows an excellent one made by Kolbè, of South Ninth Street, Philadelphia.

Many varieties of artificial legs can now also be readily obtained, in which the support is furnished by a graduated pressure around the stump; but it is to be hoped that every surgeon will, in accordance with the sentiments expressed by the American Medical Association against this variety of charlatanism, abstain from recommending limbs which are patented. Those of Kolbè have been made in accordance with my special directions, are light, neat, possess every movement, are cheap, and manufactured

Fig. 460.



Kolbè's Artificial Arm uncovered by the sleeve and glove. (After the Arm.)

Fig. 461.

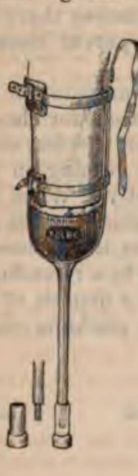


Fig. 462.

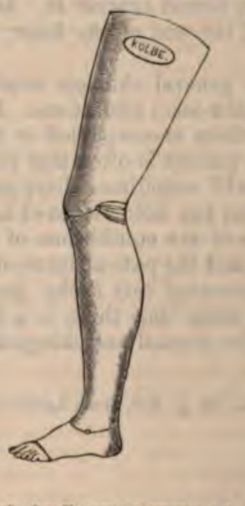


Fig. 463.

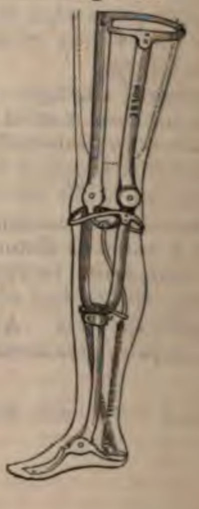


Fig. 461.—Kolbè's Peg, with extra ends, for slippery pavements, etc.
Fig. 462.—Kolbè's Artificial Leg, as it appears uncovered by the stocking.
Fig. 463.—A Section of Kolbè's Leg, showing its general mechanism. In the motion of the foot and the ankle-joint it is usually perfect. (After the Leg.)

with the distinct understanding that the crippled sufferers from amputation shall not be subjected to the evils caused by taking out a patent, Figs. 461, 462, and 463.

In Plate LXXVIII. Figs. 10, 11, are represented two boots, which will prove useful in affording support to the foot after the performance of Lisfranc's or Chopart's operation.

As a general rule, few stumps will be able to sustain the pressure arising from the constant use of a peg or an artificial limb under ten weeks after the entire healing of the wound, even when the stump is well soaked every night in a strong decoction of white-oak bark to harden the skin. In the best-formed artificial limbs, although the main support is borne by the limb above the stump, yet the strain thus put upon the newly-formed cicatrix is also very apt to induce ulceration, and this, when repeatedly established, becomes very difficult to heal. It will therefore prove desirable to omit the use of all artificial support for about three months, and then, on the appearance of increased redness in the stump, to intermit the use of the limb until the congestion of the skin has passed away. The anxiety of patients to try their artificial limbs will often create so much irritation in a newly-formed stump as to require that the movements should be regulated by the surgeon, before ulceration or sloughing of the stump is induced by ignorance or imprudence.

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Surgical Account of the Naval Battle on Lake Erie, (Gunshot Wounds,) by Usher Parsons, M.D., U. S. N., (now of Rhode Island.)—*Eclectic Repertory*, vol. ix. p. 28. 1819.

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Case of Wounded Nerve from Bleeding in the Forearm just below the Elbow, cured by Division of the Nerve, by T. Nelson, M.D. New York.—*New York Med. and Phys. Journ.*, vol. iii. p. 62. 1824.

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Femoral Exostosis, by L. A. Dugas, M. Ga.—*Am. Journ. Med. Sciences*, vol. xxvi N. S. p. 281. 185

Removal of a Ring from the Finger, wit Quicksilver, by A. C. Castle, M.D. Bo ton, Mass.—*Charleston Med. Journ.*, vo ix. p. 241. 185

Gunshot Wound of the Knee-joint, (recovery,) by W. H. Cobb, M.D. Mo.-*Western Journ. of Med. and Surg.*, vol. i N. S. p. 435. 185

Hydatid Tumor of the Arm, by S. D. Gros M.D. Louisville.—*Western Journal Med. and Surgery*, vol. i. N. S. p. 11 185

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Coxalgia, by Alden March, M.D. Albany N. Y.—*New York Journ. of Medicine*, vo xii. N. S. p. 251. 185

Benefits of Early Exercise in Coxalgia, b E. S. Cooper, M.D. Peoria, Ill.—*South Med. and Surg. Journ.*, vol. xi. N. S. 378. 185

Ulcers over the Patella, causing Necrosis followed by Suppurative Inflammation the Knee-joint, by John O. Stone, M.D New York.—*New York Journal of Med.* vol. xiv. N. S. p. 342. 1855

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ALPHABETICAL LIST

OF

AMERICAN SURGEONS,

FROM THE YEAR 1783 TO 1860 INCLUSIVE:

WITH THE

TITLES OF THEIR BOOKS AND PAPERS AS QUOTED IN THE BIBLIOGRAPHICAL INDEXES OF THE VARIOUS PARTS OF THIS WORK.

THE dissimilarity that may be noted in the number and variety of the papers assigned to the Surgeons quoted in the preceding portions of the Bibliographical Index, must not be regarded as resulting solely from the difference in the number of their publications, but rather as due to the fact that their articles were so issued as to be accessible to the Author. Some have doubtless escaped his notice, either in consequence of the limited circulation of the journals in which they were published, or from the difficulty attendant on their preservation in our libraries; but as he has carefully examined most of those printed in the last seventy-seven years, a large portion of their writings will be found to be referred to.

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